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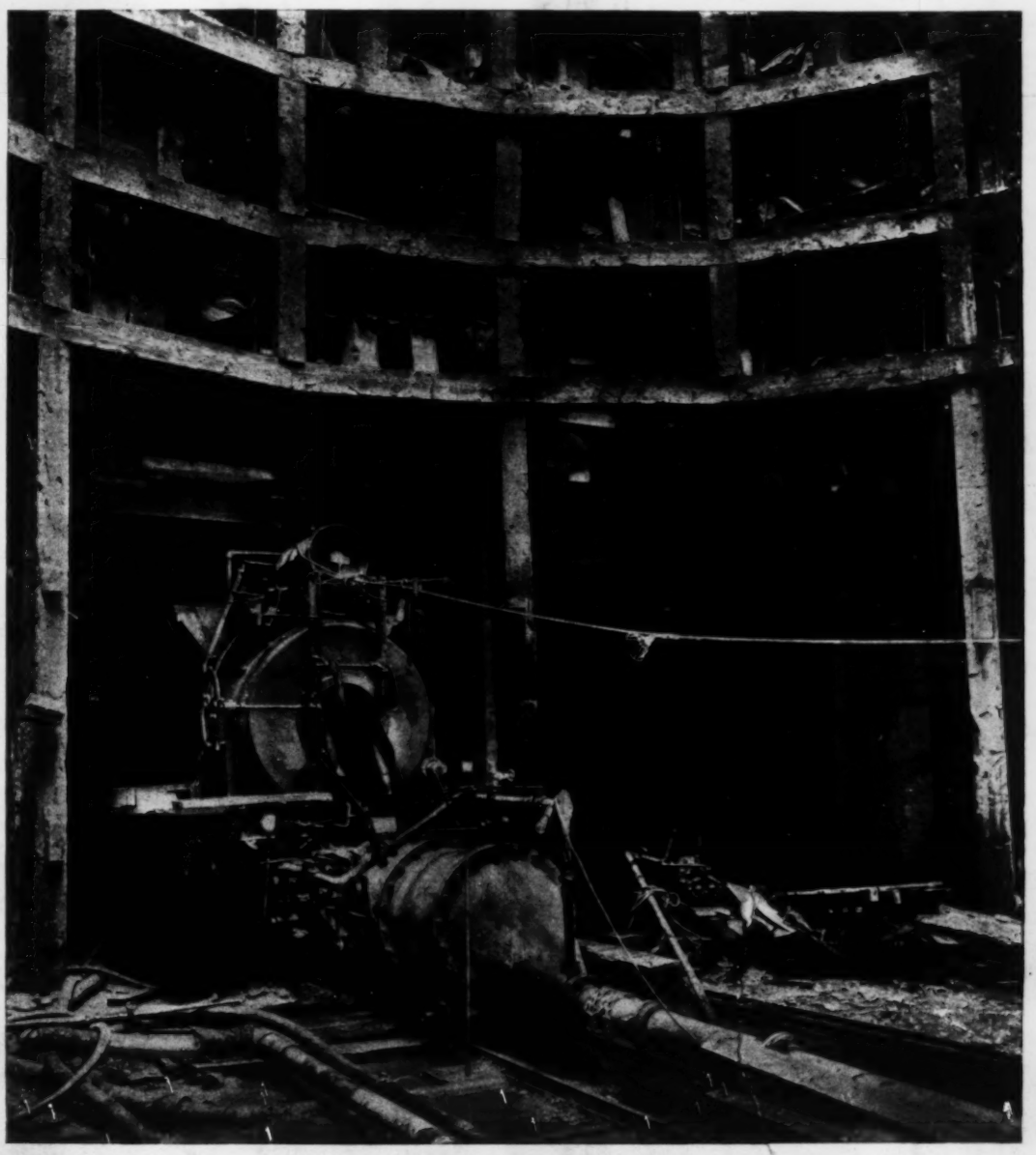
Engineering News-Record



Mixer and Concrete Gun Inside Surge Chamber: Hetch Hetchy Project in California

Double-Deck Freight Terminal for Monon Line—Placing Concrete Lining in the Hetch-Hetchy Tunnels—Planning and Building Large Motor-Vehicle Plant

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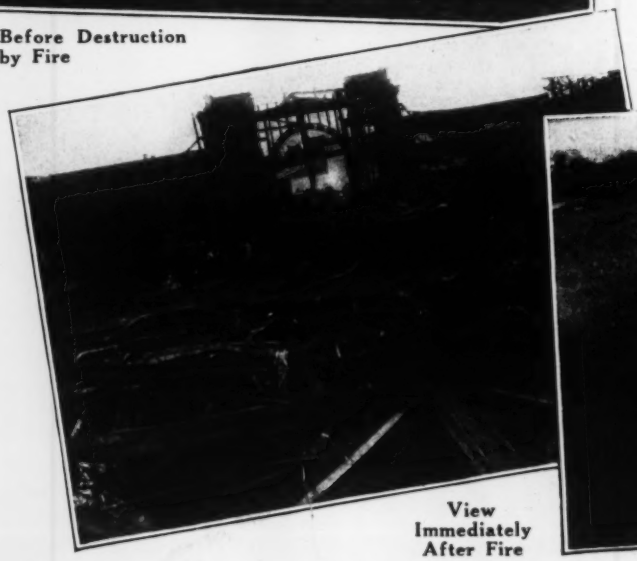

View Immediately After Fire

After Debris Removed

WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, FEBRUARY 26, 1925 Number 9

Taxation Tangles

WHETHER or not President Coolidge is right in continuing his advocacy of leaving the taxation of inheritances to the states, as he did in his address before the National Tax Association last week, he has rendered a great service to the country in calling attention to the need of correlation of our state and federal taxation systems and to the dangers of haphazard multiple taxation that in some cases threatens not merely to tax but to take all the property and leave the owner still in debt to one or another taxing authority. Confiscation dangers and mooted questions as to the wisdom of our states or nation attempting to regulate the distribution of property aside, our whole system of taxation—federal, state and municipal—needs reform. Conflicting demands, even with the best of intentions on all sides, are so great and the entire subject of taxation so complicated that a careful amassing and study of all pertinent facts and theories is needed. The National Tax Association has done much in this line, as have many economists and publicists working singly. The association adopted resolutions last week condemning as unjust the present "ill balanced and illogical state and federal death tax structure," recognizing the needs of the states for revenue from death taxes and providing for a committee to study the whole subject. The questions at issue deserve the attention of every public spirited citizen.

Job Transport Excellence

MODERN care in job transport is well exemplified in the plan of operation for the Buffalo filters whose construction is described in this issue. It can be said of course that this work was uncommonly well situated in respect to access by lake boats on one side and by railway tracks on the other, but access was only a part of the transport problem. With large volumes and the many large units to be handled the problem of rehandling was of great importance; rehandling had to be eliminated to the greatest degree possible. It is important to observe how this was accomplished. The boat landing was brought as near to the work as practicable. Here, within crane reach of the boats, the concrete mixing plant and its appurtenances were set up. After the gravel and cement boats were unloaded in one operation directly into stock, the material was not touched again until it was taken away to go into the concrete mixers. So also was the case with the materials brought in by railway—lumber, reinforcement and pipes and valves. These were unloaded from the cars directly at the places at which they were fabricated into construction units or from which they were handled directly into their places in the structure. To do this the railway lines were extended by two miles of service track which also served as means for handling excavation and fill. Cableways provided the only remaining step in distribution except for concrete. Forms, reinforcement, pipe and fittings were taken by the cableways directly from the points where they had been unloaded to the structure. Except the form lumber and the concrete materials no material had been previously handled after unloading. In brief in its direct handling of materials the Buffalo filter job stands out not only as an individual example of well planned job transport but as a particularly good illustration of the care which modern practice exercises in planning the direct handling of construction materials.

Submerging the Engineer

NEW YORK STATE is attempting to make a necessary revision of some of its departmental organization. Last year the Legislature passed resolutions proposing amendments to the state constitution embodying this reform and the current Legislature has the same resolutions before it for the necessary second passage before they are submitted to the people. There is a fair chance, therefore, of the amendments being submitted. Last year apparently the engineers did not notice the curious submergence of the state engineer's office, but it should now be called to their attention. In New York today the state engineer and surveyor is an elected officer with large powers and a wide field of activity. In the proposed constitution the state engineer disappears from the official roster of the State of New York and becomes, presumably, a mere subordinate of some one of the following newly created civil departments: Executive, Audit and Control, Taxation and Finance, Law, State, Public Works, Architecture, Conservation, Agriculture and Markets, Labor, Education, Health, Mental Hygiene, Charity, Correction, Public Service, Banking, Insurance, Civil Service, Military and Naval Affairs. Every business and profession of the world, except the ministry and engineering, has a special department to itself, but engineering is no longer to exist as a separate entity. Presumably the functions of the state engineer's office will revert to the office of the superintendent of public works who is not, by the new law, required to be an engineer as is the state engineer and surveyor by the present constitution. Making the state engineer's office appointive rather than elective is a desirable reform. It was advocated in these columns Oct. 23, 1919, p. 750. But certainly the large necessities in engineering in so great a state as New York would require that the state engineer's office be at least as important as that of architecture, education, health, or any of the other twenty new subdivisions created by the new law. The engineers of the State of New York should follow the lead of the New York Section of the American Society of Civil Engineers and get busy immediately at Albany to impress on the legislators the error in this proposed legislation.

The Concrete Gun

IT IS about fifteen years since the first experimenters began to try out the possibility of shooting a mixed concrete, of full sized aggregate, considerable distances through pipe lines by the aid of compressed air. For a number of years their efforts were not very successful. Wear in the pipes was too great, clogging was frequent, the final cost was high, but the advantages for some kinds of work were so evident that some people, not always those who started, kept on trying, in test plant and on actual work, to perfect the method. Today the concrete gun, the development of this experiment, while no more perfect than is any other of the things man makes, is certainly a workable tool and one which efficiently serves a special purpose. Throughout the West it is generally accepted as the best means of placing concrete in forms under the conditions that obtain in tunnels, where there is lack of storage space for materials, limited room for equipment and a necessity for working against gravity much of the time. In the East there is not so much of this pressure tunnel work but there are more subways, where similar conditions prevail and where the gun is usable and used. Two weeks ago, for instance, in the article on the extension of the Queensboro tunnel as a New York subway, we described the use of the Ransome gun to send concrete as far as 1,500 ft. around curves and to higher levels, and this week, in the article on the Hetch Hetchy tunnel, the effective use of another type, the Webb gun, is noted. The several types differ in details, and their application varies with conditions, but properly used they are useful additions to the constructor's tools. Those who have developed them are to be commended for working so long and arduously on a special device which has not the wide application of, say, the concrete mixer or the steam shovel, and therefore could not promise so great a reward if successfully developed.

The Cost of City Replanning

HOW costly much of the replanning of our cities will be to make up for long years of neglect of original planning or of changes in municipal development that could hardly have been foreseen is illustrated by the report on better street facilities for through traffic in Boston summarized in our news section—provisions for only a part of what Boston must do. It is not merely the high cost of the suggested improvements that is significant. Far more striking is the fact that the estimates show that of the $24,250,000 net cost of the proposed improvements about $23,000,000 will be for the taking of land and buildings, leaving only $1,150,000 for construction work. An original street layout to meet future needs, could it only have been visualized, would have cost very little extra compared with the $23,100,000 net that is now necessary to acquire land and buildings. Two things should be remembered, however: One is the very unusual sort of street plan that 'happened' decades back in Boston and the other that even a very small outlay for land for wider streets at the start would, in the many years that have elapsed since most of these streets were laid out, have stood the people of Boston large total sums in interest charges and lost taxes on the land. It should also be borne in mind that presumably the owners of the property now proposed to be taken have derived no inconsiderable revenue from the uses to which the property has been devoted, in some cases for perhaps much over a century. This, however, is no argument against right planning at the outset when it can be done with reasonable foresight; nor the imperativeness of right planning from now on in view of known conditions of increasingly heavy state traffic.

Another Utopia

GIANT power, as described in the reprint of Governor Pinchot's committee abstracted on another page, is a curious nondescript, a mixture of social reform of the familiar Utopian or "Looking Backward" sort, with a modicum of real engineering investigation. The governor himself in his message to the legislature waxes positively logical in his picture of the State of Pennsylvania under the beneficent influence of this new power plan, but for the most part this picture is the familiar one of the electric world of the future, when life is simplified, labor practically abolished and comfort made universal by the simple medium of an insulated wire leading to every home. Unfortunately, the engineering sequel to this rosy introduction does not make clear just how these reforms will be more apt to come to a Pennsylvania living under an ideal "giant power" régime than by the normal and guided progress of any other system by which electricity is produced and marketed.

In spite of the elaborate explanations of the report, the essence of "giant power" is not justified. There is the utilization of low-grade coal, the emphasis of the mine-mouth plant, the novel idea of a power reservoir, and the separation of the production, transmission and distribution of electricity, but the engineering bases are not convincing. The byproduct production would be more satisfying if one knew what is the market for all the byproducts. The mine-mouth plants would sound better if there were not reference to a minimum 20,000 ton per day of coal per mine plant, when the largest mine in the world today produces less than 10,000 tons per day. When one looks at the many plants today struggling to better 40 per cent, the 60 per cent power factor sounds somewhat idealistic, and the $75 per kilowatt first cost of power plants would be welcomed by those engineers who are having a hard time building similar plants for $100 or $125. Finally, one would like to see some explanation of how electrical energy is to be stored in this "pool" into which all of the power plants are to feed.

In other words, the engineering of the giant power surely will bear looking into. The above comments are obviously based only on a comparison of the bare statements of the report with actual engineering fact, but they are sufficiently disturbing to make further study imperative. They make it look as though the board, carried away with the social and economic promises of the scheme, were willing to have the engineering bases adjusted to fit the dream.

As we have said many times before, the production and distribution of power is the biggest social and economic problem ahead of us today. The present system of private development is by no means perfect, but it has produced amazing results in benefit to man. Before we substitute for this system of private initiative, with its enlightened self-interest, any scheme for general government ownership, such as that in Ontario, or for a veiled government ownership—for, protestations to the

contrary notwithstanding, that is what the giant power scheme would be bound to develop into—we should first thoroughly test the engineering foundations for the scheme proposed, and then make sure that there are no ways by which the old method can be relieved of some of its obvious defects. There is not much evidence that the Pennsylvania board tried very hard to do either of those two things.

Sanitary Control of the Oyster Industry

RECENT experience with alleged oyster-borne typhoid in several cities calls attention to the loose correlation of the various governmental agencies—local, state and federal—in the control of possible typhoid infection from oysters. New York City might as well be in another state so far as the powers of the New York State Department of Health are concerned—but the significance of that fact is lost in the more surprising one that the state department mentioned has no control over oyster production, although it has investigated the possible relationship between typhoid and oysters. The New York Conservation Commission is charged, among other things, with looking after the shellfish industry, but apparently from the viewpoint of the industry rather than of the public health, while for some reason, perhaps lack of funds, it seems to depend largely upon the U. S. Bureau of Chemistry for data as to the wholesomeness of oysters. In a number of other, though fortunately not all, states, conditions also against the fullest possible sanitary control of oyster production exist. Chicago and the State of Illinois, like many other cities and states, are so far removed from the seat of the oyster industry that they can not readily have much knowledge of oysters until they cross the state boundary, which makes full sanitary control of oysters a matter of federal as well as state action.

Here three federal departments come in, Treasury, Agriculture and Commerce, acting through the Public Health Service, the Bureau of Chemistry and the Bureau of Fisheries. The latter, like the New York State Conservation Commission, is primarily concerned with the industry rather than the public health. The Bureau of Chemistry has more or less to do with seeing that the oyster is fit for consumption. The Public Health Service has certain powers of investigation of food supplies in relation to public health, of little avail unless money and men are provided to make the exercise of those powers effective. It can, under some conditions, investigate an outbreak of communicable disease, but this power, valuable as it has proved in many cases, often amounts to but little except as a post mortem and to point the way to guard against more deaths from the same cause later on. This is well illustrated by the recent typhoid outbreaks. Although the Health Service report on this subject, printed in our last issue, states that "observations of the situation in Chicago and New York were made by our officers from the first appearance of an excessive prevalence of typhoid fever in those cities early in December," yet the "intensive studies" were not begun in New York City until Jan. 5, in Chicago and the District of Columbia until Jan. 12 and in other cities "on or about Jan. 23." And yet the infection of oysters determined on by the Public Health Service as responsible for the outbreak is given in the report as between Oct. 25 and Dec. 20, while the last named date was the end of the week of largest number of cases reported in New York City.

The foregoing considerations, together with those presented last week under the head, "Indicting the Oyster Industry," show that there is need for more and better control of the shellfish industry, and that this need extends also, as the Health Service report urges, to interstate traffic in "vegetables, fruits, milk, milk products, and other foods eaten usually or frequently without being cooked." Interstate control can be vested in one or more federal departments. There is great need for careful consideration of whether it is practicable to centralize it in a single department, and if so in which and if not how the divided powers may be better correlated than at present. The same study needs to be given to some other interstate health matters, including here not only a centralization in one state department or a correlated division between two or more but also an allocation of powers between state and cities.

The eight guiding principles in oyster control adopted last week in Washington, and printed in our current news section, avoid allocation and correlation of control as regards health, fisheries and food and drug departments of either state or federal governments. They are not quite so non-committal as to the relative parts to be played by the cities, the states and the nation. Details, properly, have been left to a program committee.

The whole matter being primarily one of health, but secondarily and vitally one of industry also, the several health services, each in its own domain and all through concert of action, must dominate, while fishery departments and food and drug agencies should co-operate. Duplication and triplication of control at points of origin, with still further multiplications of control as oysters get into interstate commerce, must be prevented.

The so-called Treasury system of certification of water supplies on interstate carriers, under which state health departments make reports and recommendations to the Public Health Service which then certifies or refuses to certify, points the way to the control of oysters in interstate traffic and, the states consenting, could be adjusted to the intrastate oyster trade as well. New Jersey has had the sanitary protection of oysters produced in her own waters well in hand for several years. Maryland also exercises large measures of control. Connecticut has but recently adopted, with slight changes, the 1924 revision of the New Jersey regulations. In each of these states the health department seems to have all needed powers within its domain, but in some of the other oyster-producing districts the state health department has no jurisdiction, as in New York and Virginia, or can act only on complaints received, as in Massachusetts.

The present session of Congress is so near an end that little can be expected from it as a contribution towards better oyster control. A reasonable appropriation to the Public Health Service would meet the more urgent needs. The legislatures of most, if not all, the oyster-producing states are now in session, and many of the legislatures of non-oyster producing states also. Not one of these should adjourn without giving its state health department whatever power and funds it may need for the sanitary control of oysters—and, where lacking, of milk and other foods that may spread typhoid. If the cities of some states need more power and funds to the same end they also should be armed against the common enemy.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Planning and Building a Large Motor Vehicle Plant

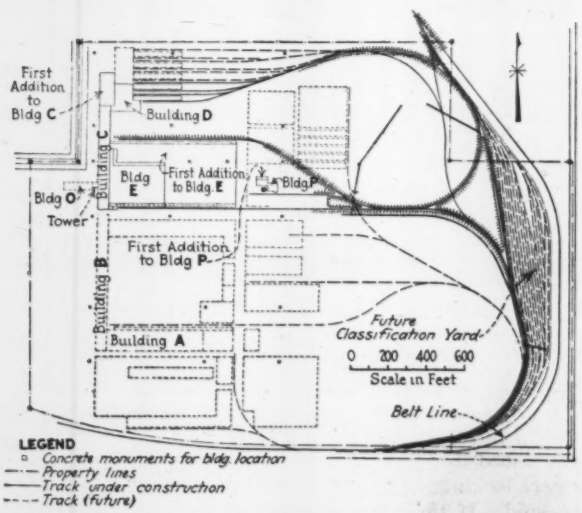
Methods of Approach to Technical Problems and Solution of Those Problems in Layout and Construction of the Motor Vehicle Assembly Plant of the International Harvester Co., at Fort Wayne, Ind.

BY EDWIN M. CHANCE
Engineering Manager, Day & Zimmermann, Inc., Engineers, New York, Philadelphia, Chicago

The purpose of this article is to discuss some of the fundamental considerations that enter into the design and construction of a large industrial plant. The example chosen is the new motor vehicle assembly plant that the International Harvester Co. has recently built on unimproved farmland at Fort Wayne, Ind. The detail of the structure is not given, but instead the method and the approach to the various technical problems in plant layout and construction, but there are given drawings showing the general design and photographs of the completed plant, with descriptive captions noting the application of the general principles to the specific case.—EDITOR.

INDIANA'S newest industrial plant, the Fort Wayne works of the International Harvester Co., is one of the large plants in the automotive industry. The plant, devoted to the assembly of motor trucks, is designed for unusually large ultimate capacity and exemplifies the progress of modern industrial planning.

Its location at Fort Wayne is strategic, near what might be called the center of gravity of the automotive industry, 148 miles from Chicago, 146 miles from Detroit, 187 miles from Cleveland and 120 miles from Indianapolis. The purpose of the new plant was to provide an efficient, large-capacity assembling plant for motor trucks, destined both for domestic and export markets; the company had outgrown its manufacturing and assembling facilities elsewhere. Looking towards the future, it was the purpose to provide, in the ultimate layout, for the addition of complete manufacturing facilities at this plant, when and if required. The first plant units, however, were to be designed, and now as built are being used, for assembling trucks and for some minor manufacturing operations. The plant as at present built has floor area of some 450,000 square feet.



PROPERTY SURVEY AND RAILROAD CLASSIFICATION YARD LAYOUT
The site is approximately 2,000 x 2,800 ft.

Character of Construction—The plant buildings comprise a multi-story building and single-story and two-story "saw-tooth" buildings.

The character of the construction is a structural steel framework, with reinforced-concrete floor slabs, wood block floors, brick curtain walls, precast gypsum roof, and hollow-tile temporary partition walls which may be removed for future extension.

Selection of Plant Location—When an industrial executive and his engineers have to make selection of the location for a large industrial plant, a plant that is destined to be a factor in its industry, there are a host of conditions and factors that must be taken into account. When one considers the great advantages in natural resources that are found so widespread in our country, the complexities in a selection are apparent. However, the concentration of population, and by the same token, the concentration of general buying power along the Atlantic seaboard, have long ago established certain industrial advantages for large manufacturing plants east of the Mississippi. But north and south, east and west, within this area in which are located twenty-six of the forty-eight states, the problem of selection nearly always is one to which there are many angles.

Among the various factors that enter into the problem of selection are the sources of raw material; sources for obtaining semi-finished or finished parts; market for the product; transportation service and rates; labor market—skilled and unskilled, men and women; prevailing wage rates; cost of power and fuel; municipal advantages; housing facilities; suitability of site; convenience of location; and, possibly, advertising value. All of these features must be weighed in making the final selection.

Problem of Plant Design—Broadly, the industrial engineering problem with which the engineers found themselves confronted was to design the most economical plant layout which would meet the demands of a production schedule that had been determined upon, would fit the many and varied processes of manufacture,

take each process in its logical sequence, insure that the many departmental areas and capacities be of proper size and in correct relationship one with another, and provide that the physical location of the plant on the property would be such that the initial plant units would fit in with an ultimate layout that would permit almost unlimited expansion.

The development program called then for a complete automotive truck manufacturing and assembling plant, to be built in successive stages as the growth of the business justified.

The line of trucks constituting the present or future output of the plant embraces some six different sizes, from a light speed truck up to a heavy-duty truck, with modifications to meet special requirements.

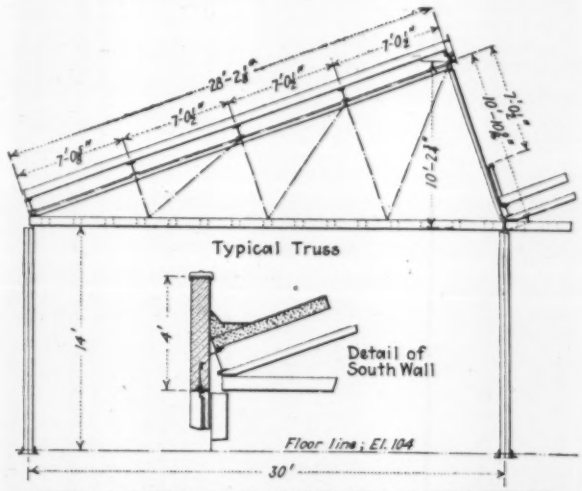
Among the steps that are taken in an industrial survey which precedes but is necessary to the actual design, are these:

To investigate the site; to analyze the plant requirements and establish the sequence of processes; to determine the departmental areas; to prove the preliminary layout; to select the building types; and to estimate the cost of the project. Something will be said about each step in the following:

Investigating the Site—In any industrial layout, the first requirement needed when starting the plant design is naturally a topographic survey map of the property. The designing engineer must have also exact information as to the bearing value of the soil. He must know the size, location, and elevation of the nearest sewers, water, and gas mains. Naturally he must know of available electric power sources, character of service and rates. He must have information which will assure his compliance with the local building laws and the state regulations as to sanitary, safety and welfare provisions. The first importance of railroad facilities is self evident.

An early inspection of the site gives the designing engineer a mental picture of the local conditions which have a bearing on the plant arrangement. Imagination is essential in almost any engineering undertaking. In the layout of a large industrial plant it is a most necessary qualification for the designing engineer. This early inspection accomplishes many things. It is the introduction to a study which should be made of the relationship of the site to its environment. There must be determined such matters as in which direction the plant should front; the relative location of highways and housing districts, present or proposed; convenient entrance points for employees; local transportation facilities for commuters; desirable entrance points for railroad sidings; location of nearest passenger and freight stations; the possible effect of topography on building locations and floor elevations—there are many more features, too numerous to designate.

A word as to the effect of the property upon the general arrangement of the plant. Where there are no property restrictions, the plant can be laid out along ideal lines to suit the process and production require-

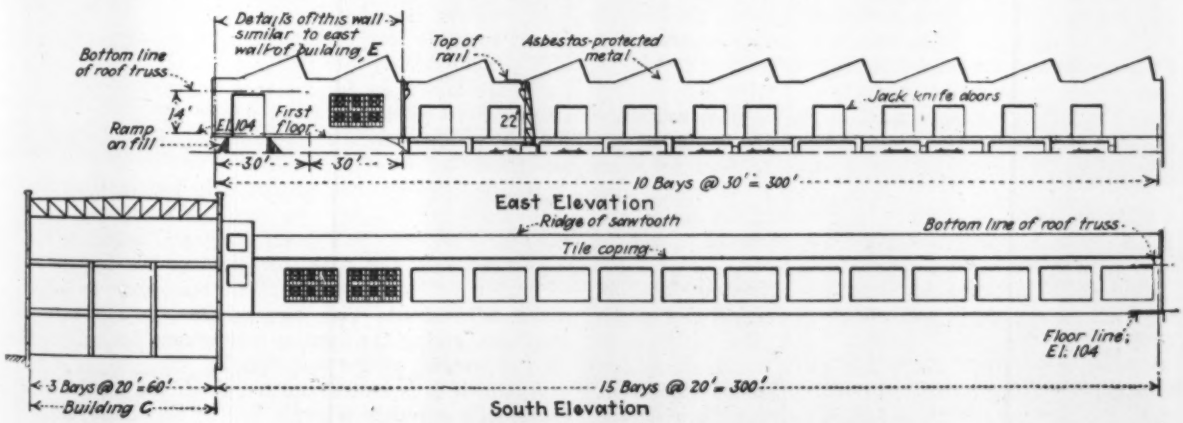


TYPICAL DETAILS OF SAW-TOOTH CONSTRUCTION

ments, minimize the cost of production, of storage and handling, and provide for future expansion. The purchase of the site after the ideal layout has been established is the preferable way, but this method is not always practicable. The more usual procedure is to acquire property before the design is undertaken, which appears to be amply large for the immediate purpose with enough extra space for a reasonable enlargement.

In the case of the Fort Wayne plant, the large tract of some 142 acres was acquired prior to the layout of the plant. The character of the site is such that boundary restrictions were practically eliminated so far as affecting the layout.

Analyzing the Plant Requirements—The modern industrial plant is built to fit the manufacturing processes and the production requirements. This could



SAW-TOOTH CONSTRUCTION OF SINGLE-STORY BUILDINGS

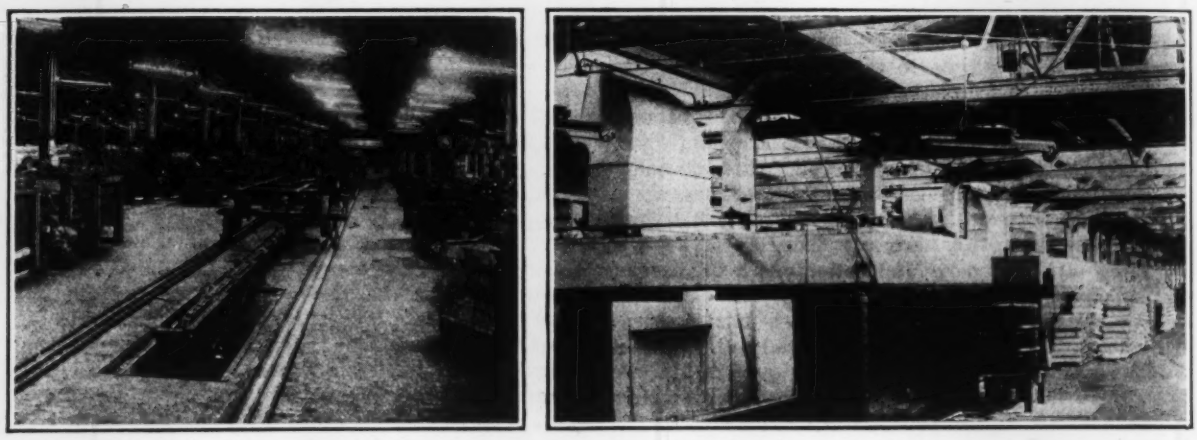
hardly be said of earlier American factory building practice, nor was much thought given to future expansion. Of primary importance today is the establishment of these considerations for the particular plant. The immediate production requirements can be definitely established, but probable future development must necessarily be tentative inasmuch as it is based largely on a common-sense estimate of the future, supported by such investigational study as can be made.

The problem of plant layout with respect to sequence of processes is one which merits close analytical study. There must be established a proper relationship between departments in order to obtain a progressive flow of materials with the minimum amount of handling. It is here that the determining characteristics of one type of plant, as against another, are manifest. In the Fort Wayne project, although intended at first to be an assembly plant for units manufactured in other International plants, it was necessary to develop a complete manufacturing and assembly layout, so that the first building group could properly be located on the property in order to establish the total length of the "assembly line" and the relative physical positions of the part storage departments, the sub-assembly and the manufacturing departments.

The designing engineer must project his analysis in terms of materials and time. The time element at each assembly station is important as it affects the production rate per line, and consequently the number of complete assembly lines needed for a specified yearly production rate.

In respect to this onward moving production river, made up of materials being assembled progressively and its flow measured in terms of time, another factor obviously comes into the picture, the factor of space or area. So it may be necessary to double up or stretch out the line at congestion points.

Take an instance in the automotive industry: the length and number of paint-drying ovens after spray-painting will vary with the time required for drying. Or a further instance, the color varnish coat applied to the chassis after assembly may require twice the drying time needed for the prime and clear varnish coats. This is the kind of intimate study which the designing engineer must make before he can intelligently develop the assembly line.



ASSEMBLY LINE OPERATION BY NIGHT AND BY DAY

The view at the left shows the mercury-arc lighting for night work. At the right is shown one of the paint drying ovens, through which the assembled chassis is passed by means of the chain conveyor, after the paint spraying process.

in respect to logical relationship with the manufacturing units if these should be added in the future.

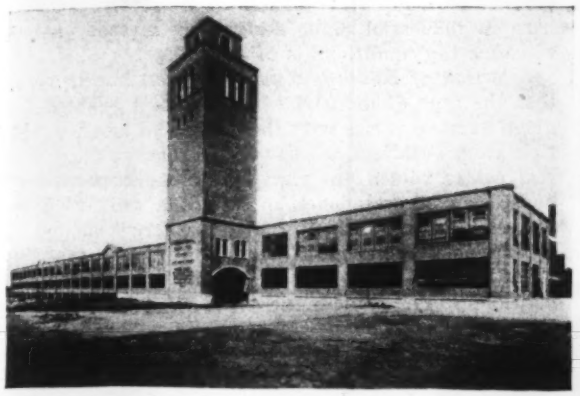
The outstanding characteristic of an automotive assembly plant is the so-called "assembly line," to which all parts entering into the finished truck must flow. It is not unlike a river, always flowing forward, and constantly increasing in volume through the flow of streams which enter from the sides. A moving assembly with continuous conveyors is frequently used in plants specializing in quantity production. In truck manufacture the more common practice is to have assembly stations at fixed locations and to move the truck chassis intermittently from station to station, first on shop "dollies" and later on its own wheels. Through the drying ovens or at inclines, mechanical conveyors are generally used, for haulage. The flow of parts is obviously to the various assembly stations.

The designing engineer must be intimately familiar with all of the parts and all of the operations which enter into the final product. In the automotive industry, the order in which unit parts should be assembled varies somewhat with different makes of cars and trucks. With a full knowledge then of the sequence of assembly operations, the engineer determines first the number of assembly stations per "line,"

Returning to our discussion, the fixing of the assembly stations in logical sequence establishes the delivery points to which the materials should flow. Adjacent to these stations should be stored the respective unit parts entering into the truck at this point. If the parts are bulky, as for instance bodies, it may be desirable to store them on an upper floor, and through hatchways lower them to the assembly line at the body-mount station.

The development of the assembly line will establish just how behind the finished part storage there should be located the sub-assembly and manufacturing departments in the order dictated always by the flow of materials. In practice it is necessary usually to make adjustments and compromises in departmental locations, giving the routing preference to bulk, quantity, or weight, as the case may be.

Again, if it is an automotive plant, the layout would establish a sequence wherein behind the manufacturing departments, where for instance the engines, transmissions, differentials, axles, and so forth, are machined,

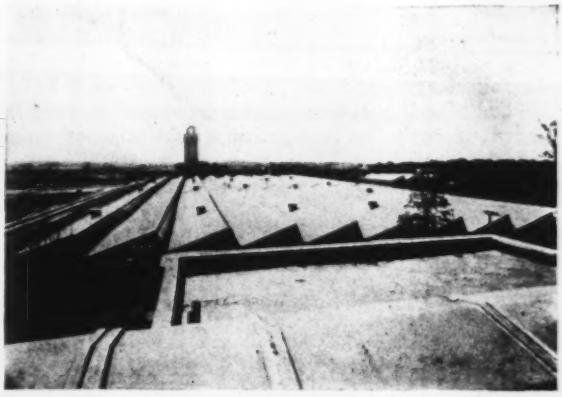


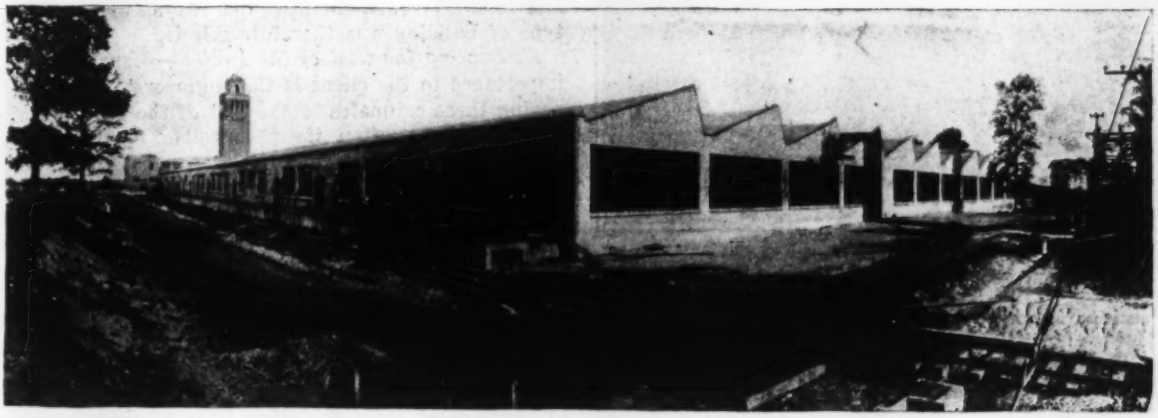
Multiple-Story Building, with Plant Tower at Front of Works

The two main floors are devoted to administration, manufacture, assembly and test, and research laboratory. In the basement, at the left, are the local distribution and service headquarters for the Fort Wayne district; this three-story section was obtained from the natural contour of the site; length along building front is 780 ft. The tower is the outstanding architectural feature of the plant and has become a landmark; its height is 160 ft. and it contains the 100,000-gal. sprinkler tank for plant fire protection.

Saw Tooth Construction (Below)

View taken from roof of power plant, showing 350 x 680-ft. expanse of saw-tooth roof construction. In the foreground is seen one of the transformer stations—seven such stations supply the plant.



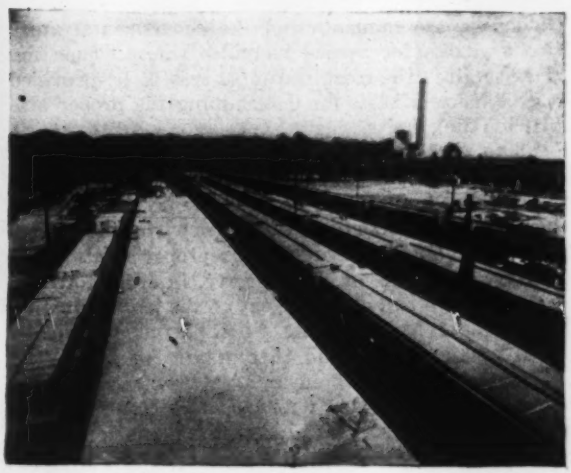


Buildings of Fort Wayne Works of International Harvester Co. for Motor Vehicle Assembly

Showing saw-tooth construction. In the foreground is one of the unloading platforms. This unloading platform combines a tunnel from the power plant on the right (not seen) to the plant pump room and to one of the two electric power distribution centers, at the far end of the platform. The tunnel carries steam, compressed air and power and light lines.

Inside the Saw Tooth (Above)

Typical 20 x 30 bays; north lighting; gypsum roof slab; wood block floor; forced draft heating; mercury arc lighting; 14-ft. clearance under bottom of truss.

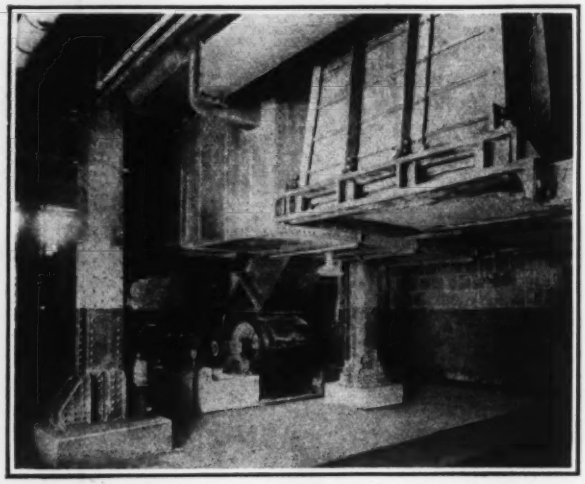


Loading Platforms: Domestic and Export Shipment

would be the orgininating departments, such as foundries and forge shops, with such auxiliary as heat treatment, convenient to the machine shop as well as the foundry.

The purpose of the foregoing discussion is to make clear to the reader the great importance which this analytical study has in its effect upon the later actual design of plant. The study has established diagrammatically the sequence of processes and the flow of materials.

Determining the Departmental Areas—To make definite determination of areas, the space requirements both for storage and for manufacturing must be established exactly. It is necessary to dissect each of the finished products, in this instance each size of truck,



BASEMENT OF BOILER HOUSE

Ash hoppers are arranged for ash removal by truck. The two forced-draft fans are respectively motor-driven and dual-drive (electric and steam). Column bases are protected from moisture by use of concrete.

by analyzing its component parts or units installed along the assembly line. The amount of space required for assembly stores is a function of the number of days' or weeks' supplies to be stored ahead of the assembly schedule, for different classes of materials. With the quantity settled, the number of units per square foot of floor space can be readily determined. In analyzing the production rate of different departments, the units of output are reduced to a floor-space basis.

Obviously, the summation of the departmental areas with allowances for needed increases where congestion may exist gives the combined total area to be provided and establishes a basis for determining the proper size of the building units.

Proving the Preliminary Layout—The general characteristics having been developed, the next step is to prove the preliminary layout. This may be done by using templets representing various departmental areas, drawn to scale and placed in their proper relationship on a large scale plan of the property, in order to check the general size and arrangement of the plant. In this way alternate arrangements of departments can be studied and compared and that arrangement offering the greatest number of advantages is then developed in greater detail, until a final layout is secured which meets every requirement. Always, the needs for future expansion must be heeded.

As in so many other phases of engineering work, so here in industrial plant design any method that will *visualize* the conditions is of advantage.

Selection of Building Types—It need hardly be said that the type of industrial building best adopted for a given purpose varies with the usage and location. Multiple-story buildings are usually justified in cities where real estate values are high and the processes can be housed on several floors, or where a gravity flow of materials is possible. In general, where sufficient land is available, economy of operation favors the single story building or at least a combination of single and multiple story. Unless the plant or department is of exceptional size, single-story buildings have a number of advantages from the standpoint of convenience and arrangement, flexibility of routing and handling of materials, and adjustable expansion. It can be more readily enlarged as needed than the multiple-story building. The slightly higher initial cost of the high-grade single-story building is usually offset by greater intensity of utilization, greater operating economy, and greater flexibility. With the varied lines of manufacture and assembly entering into automotive construction, a combination of single and multiple-story buildings offered the greatest advantages both in the initial and future layouts, for the Fort Wayne project. This type of building was therefore selected.

Estimating the Cost of the Project—Usually of vital importance to the client is the engineers' work in preparing those estimates of the cost of the project which will determine often its permissible magnitude and scope. Engineering concerns itself not alone with physical layout and the technique of industrial processes but also with those economic considerations which must be recognized as a determining criterion or "yardstick" in the measure of any industrial plant layout.

Ultimate Layout of the Plant—The general property plan of the project shows those buildings which have been completed and indicates the development of future buildings comprised in the proposed ultimate layout. In the design, the possibility of utilizing the buildings or portions of them for other lines of manufacturing also received consideration. The present and future development of transportation facilities available to the plant are shown, together with the future classification yard which will be a part of the belt line that connects this plant with the four main trunk-line railroads at Fort Wayne.

The architectural treatment of the exterior of the plant buildings was turned over to Holabird and Roche, of Chicago, who acted as consulting architects of this feature of the work.

Constructing the Plant—The industrial layout having been completed and adopted, estimates made, detail plans and specifications prepared, bids taken, and contracts awarded, the construction of the plant proceeded under the supervision of the engineers.

The greater part of the work was carried through upon a minor-contract basis, that is, through the direct employment of contractors who were specialists in each trade. That portion of the work which was not so handled was carried through directly by the construction forces of the engineers. The functions of the engineers as related to the construction were these: to schedule all construction work; to co-ordinate the work of all contractors; to assist in the expediting of materials

in order to meet the construction schedule; to supervise and expedite all work and materials; and to provide for all accounting and to maintain adequate cost records. These functions will be briefly discussed.

Scheduling — The engineers made careful analysis of the time element under each contract, in terms of man-hours, from which was developed a time schedule for the whole job. This established the date of start and completion of each contractor's work and the time relationship one contract with another.

Co-ordination of Work—Stated conferences with the contractors discussed the sequence of work and maintenance of schedule. When necessary, revisions in schedule were made to permit modification of performance in terms of conditions which had arisen, if any. Schedules were checked months ahead with contractors not yet in the field.

Expediting of Materials—Assistance was given to contractors where necessary to expedite shipments from point of origin to the job, in order to maintain the schedule.

Inspection of Work and Materials—A corps of inspectors, consisting of civil, mechanical and electrical engineers, as well as architectural inspectors, was assigned to the work in the field. The progress of all construction, as well as the inspection of all material, was under the direct supervision of this corps. Progress records were maintained and were reported daily to the engineers' home office and to the client.

Accounting — Accounting covering the entire construction was carried through. Classifications of cost were used which conformed with the engineers' standard classification of construction accounts, and supplied the "break down" required by the client for insurance purposes. Current cost records, rigorously up to date and including unit costs of construction, were maintained throughout the job and made available likewise to the engineers' home office and to the client. Graphic charts were used to advantage to visualize the current situation.

Certificates of payment to contractors were originated in the field engineer's office, checked by the field accountant, and upon certification by the field engineer were passed to the client for payment.

The plant was designed and built under the supervision of Day & Zimmermann, Inc.

Franco-Swiss Pact for Using Rhine River Flow

With the return of Alsace to France a new situation was brought about with the respect to the flow of Rhine water below Bale in Switzerland. France, as indeed was Germany before the war, is very much concerned as to the bulk of the flow in the mid and lower Rhine before it reaches Dutch territory and the present situation has made it necessary for a fixed agreement with Switzerland. The Swiss federal council has conceded to the Société des Forces Motrices du Haut Rhin at Mulhouse in Alsace, a French company, the privilege of taking water in Swiss territory as far as the juncture of the river Birse, and has so notified the French government. A project by the French engineer Kembs contemplates the construction of a barrage 5 km. below the Swiss frontier which canalization will carry the flow through two branches, one for the use of the electric company, and the other for navigation purposes thus avoiding the rapids in this region.

Traffic Delay Rather Than Safety Governs in Grade Crossing Elimination

By Arthur Richards
City Engineer, Chillicothe, Ohio

AT THE recent National Conference on Street and Highway Safety held at Washington, D. C., under the direction of Secretary Herbert Hoover, the conference approved the following item on grade crossings:

"The elimination and protection of grade crossings are of such importance and involve to such an extent the public safety as to require that priority be given to them, in the allocation of capital funds by the railroads, and of public moneys for highway building over expenditures for other safety measures designed to protect the public."

The latest report of the Interstate Commerce Commission shows that there are 258,786 grade crossings in the United States, of which less than one-fifth are protected in any manner. In the past two years 8,114 new grade crossings were brought into existence and as only 1,839 crossings were eliminated there remains a net yearly increase of over 3,000 crossings.

If it is contemplated that grade crossing separations and eliminations are to be made primarily for the purpose of safety then the conference is confronted with a hopeless and endless task as neither the public nor the railroads would agree to finance such an undertaking.

In the case of the particular crossing mentioned below there never has been much thought given to the subject of safety at the crossing as protection gates are used and no serious accident has ever occurred. The trouble has been "too much delay," which has been a serious annoyance for the past twenty years or more.

The people of Chillicothe, Ohio, a city of 16,000 population, voted five to one for a $100,000 bond issue to pay the city's portion (35 per cent of the aggregate) of the cost of having a grade separation on Main St. at the site where the Baltimore & Ohio, and the Norfolk & Western railroads cross the street. The bonds were voted mainly for the traffic convenience of the public, the question of safety being of relative unimportance.

For the purpose of considering the economic value to the city of Chillicothe through the construction of a proposed grade separation at the Main St. crossing, a traffic census was taken for a week's duration in order to get some idea of the amount of delay at the crossing and the number of people involved.

The census shows that as an average the railroad protection gates were closed 70 times each day for a total of three hours out of the ten-hour period, that the shortest length of time closed was one minute and the longest time ten minutes. The average number of vehicles which passed over the crossing during the daily observed period was 1,916 and the number of pedestrians 1,829. The pedestrians equaled 11.4 per cent of the city's population and if we allow two persons to each vehicle then the total number of people which passed equaled 35.4 per cent of the population. The daily economic loss sustained by the people of Chillicothe due to traffic delay at the Main St. crossing during the daily ten-hour period from 7 a.m. to 5 p.m. is equal to not less than 2,500 man-hours.

It therefore is evident that traffic delay rather than traffic safety is the governing factor which will justify the expenditure of over $300,000 for this particular improvement.

Placing Concrete Lining in the Hetch Hetchy Tunnels

Mixer and Pneumatic Gun in One Self-Contained Unit Which Moves Along Track—Wood Arch Forms Used—Belt Conveyors Deliver Concrete Materials—Crew Has Advanced 4,000 Ft. in Month

By W. F. Webb
Contracting Engineer, Groveland, Calif.

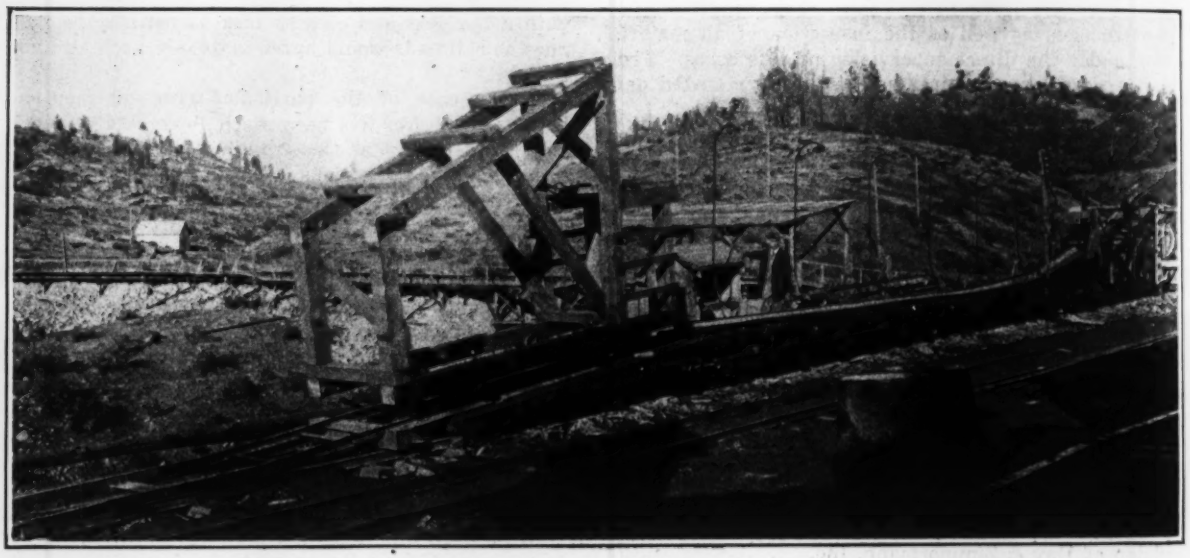
CONCRETE lining is being placed in about two-thirds the length of the 18-mile tunnel in the mountain division of the Hetch Hetchy development, San Francisco's water-supply project. All lining materials are taken into the tunnel either at Priest portal or through the Big Creek shaft, despite the fact that using only these two points of entry meant underground delivery of concrete materials for distances ranging up to 7¼ miles. This plan was decided upon because these two points were on the Hetch Hetchy railroad, and to establish material plants at other points of entry would have meant supplementing the railroad haul by motor truck delivery. To adapt construction methods to the requirements of long underground haul, a self-contained lining unit was developed which can be moved bodily along the tunnel track and which includes facilities and equipment for storing materials and for mixing and placing the concrete, the latter being by the pneumatic placement method through a 6-in. delivery pipe ranging up to 300 ft. in length.

A primary advantage in having the mixer close to the work is that, by delivering the materials dry, delays in transit do not affect the quality of the materials on arrival at the work, and hence there is neither uncertainty about the quality of concrete that goes into the forms nor loss due to rejected concrete. The concrete is in place a few seconds after leaving the mixer without waste and in the best of condition. The use of a complete mixing and delivering plant on wheels has worked out very successfully; in the 29 working days of last August a total of 4,002 lin.ft. of walls and arch requiring 7,200 cu.yd. of concrete was placed by one gun, which is believed to be a record for this class of work.

In making preliminary plans for lining operations it was decided to work eastward 20,500 ft. from Priest portal, which would carry the work to Garrote shaft while the plant set up at Big Creek shaft would serve to line westward 15,300 ft. to Garrote and eastward 7¼ miles to South Fork crossing. From Big Creek east the tunnel was to be lined continuously for the first 22,700 ft. and thereafter lining was specified only in selected portions. The main tunnel, 18 miles in length, has a diameter of 10 ft. 3 in. inside the concrete lining. The power tunnel extending from the reservoir at Priest portal to the head of the Mocassin Creek penstocks, slightly more than a mile, is on a steeper grade and is 13 ft. in diameter, thus being able to supply power demands with low friction loss.

While the tunnel was still in process of being driven, crushing plants were installed and muck coming from the tunnels was put through these plants and stockpiled. At Priest portal sufficient material was thus stocked on the hillside above the portal proper to complete the lining from that point to Garrote. This material was easily yarded into an assembling plant by means of drag scrapers. At Big Creek the material was stocked on the dump already formed and later on was yarded in as at Priest portal.

At Priest portal a plant for assembling the sand, rock and cement was erected and all materials were handled to the measuring box by means of belt conveyors or chutes. From the measuring box the materials were loaded into a 3-compartment, bottom-discharge car for transportation into the tunnel. Each compartment of the car carried sufficient sand, rock and cement to make a batch for the mixer. Seven cars constituted a train and from 2 to 5 trains were used,



REAR VIEW OF MIXING-PLACING UNIT FOR CONCRETING LINING OF HETCH HETCHY TUNNELS
This shows the elevated track under which the belt conveyor runs. Gun and delivery pipe sections not attached. The timber section on the incline is part of the delivery pipe support; this is ahead of the gun when in operation.

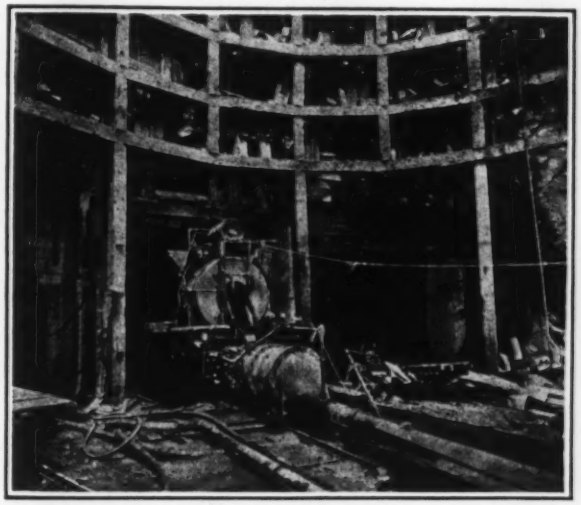
depending on the distance from the plant to the work. The number of trains and electric locomotives of the storage battery type as well as the location of passing tracks was worked out so that the dry batches were delivered to the mixing plant at regular intervals, regardless of the length of haul.

Electric energy went into the tunnel in a 2,200-volt primary cable to a point about 1,000 ft. from the lining plant, where the voltage was reduced to 220 by transformers. The transformers were mounted on a flatcar and thus were easily moved when occasion required.

From the transformers the 220-volt current was carried to the mixing and placing unit by a cable wound on a reel mounted on the unit itself. The 220-volt current was used directly for operating the mixer and the belt conveyor while a small transformer reduced the voltage to 110 for lighting purposes. When the unit had moved ahead so that the 1,000 ft. of 220-volt cable had been almost all reeled up, the flatcar containing the transformers was again moved ahead; thus light and power were always available on the unit except when the large transformers were being moved.

On arrival at the tunnel-lining plant, the 7 cars of a train (having been pushed in ahead of the locomotive) were pulled up an incline onto an elevated track by a mechanical hoist. Under this elevated track a continuous belt conveyor received the materials from the several cars successively, delivering each batch to the hopper of the concrete mixer. The mixer was mounted on the rear end of a concrete gun whose capacity was the same as that of the mixer. From the gun the concrete was shot into the forms under an air pressure of 100 lb. per square inch.

Elevated track, mixer, gun and the delivery pipe from the gun are all mounted on wheels and connected together in a single unit about 150 ft. in length. This entire unit moved ahead on the 24-in.-gage track originally laid when the tunnel was being driven, and thus was moved ahead as fast as the concrete forms were filled. About 15 to 20 minutes was sufficient to move the entire plant the 140 ft. which usually constituted the length of a move. Shorter moves were made unnecessary by removing 5-ft. sections of the delivery pipe as the work advanced.



MIXER AND GUN IN BOTTOM OF SURGE CHAMBER
Note delivery pipe in foreground, wheels under gun, and struts under mixer platform to brace and steady it while in operation. Gun operator's station is on ground beside gun. Surge chamber lining not yet placed.

Water for the concrete batches was brought in in a 4-in. pipe and compressed air for operating the concrete gun and the hoist by another 4-in. pipe line.

The entire mixing and placing plant is built up in short sections connected along both sides by means of pin hinges. This arrangement was used in order to permit the unit to swing around curves. While rounding curves pins on the outside of the curve are pulled.

TUNNEL INTERIOR SHOWING FORMS OF THE WOODEN TYPE
Jacks on car in background with which form sections are raised for moving. Hooks on ribs are for holding form sides close to car while moving

In placing the concrete lining in the Hetch Hetchy tunnels a combination form was used built up in sections 20 ft. long hinged at three points, i.e., along the center of the arch and on either side near the bottom. The ribs, girders and braces of these forms were of steel. The lagging consisted of 2x6-in. pieces spiked to nailing strips that were bolted to the steel ribs. The lagging extended the full 20-ft. length of the collapsible form section. Two 20-ft. form sections were handled at a time by means of jacks and carriers mounted on wheels. Ordinarily a form setup 120 to 140 ft. long was made at a time, about 5 hours being required to take down and set up this length of form.

From 120 to 140 ft. of wall and arch were ordinarily poured in 12 to 16 hours, depending on the yardage of concrete required. The amount of concrete required in the walls and arch averaged about 1¾ cu.yd. per linear foot.

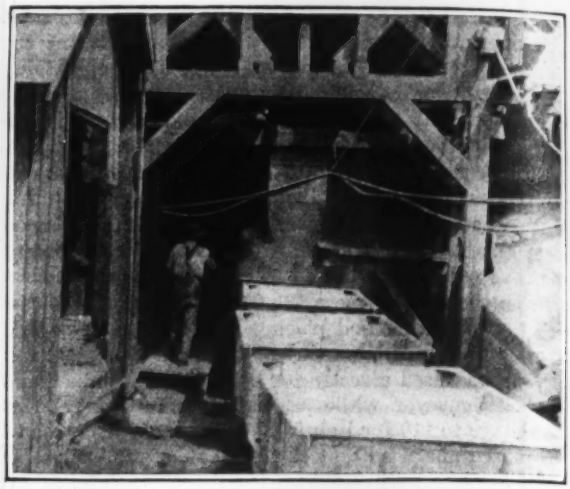
In the tunnel between Priest portal and the Moccasin

LOOKING AHEAD FROM BESIDE DELIVERY PIPE
Delivery pipe on top of frame at left. Note sack bulkhead in forms at right being built with sacks of sawdust lying in foreground.

Creek penstock wood forms were used exclusively, built up in sections 9 ft. 6 in. long and hinged as were the combination forms. The ribs of the wood forms were laminated, being made up of segments cut from 1-in. boards. There were several curves in this tunnel, all of them on a 60-ft. radius, but no additional forms were built for this work; by a little jockeying the 9-ft. 6-in. forms were made to fit and a very neat job resulted.

One 8-hr. shift was allotted for moving and setting up forms and two 8-hr. shifts for placing the concrete. After the crews were broken in both operations were usually completed in less than the allotted time. A foreman and 8 men comprised a gun and mixer crew. About 27 men were used in the form crew.

After trying various methods of bulkheading the ends of the forms to finish off the day's work, the best plan



LOADING THE 3-BATCH CARS AT PRIEST PORTAL
Materials come by gravity from hillside stockpiles and through bunkers into 3-compartment cars which take dry batches to mixer.

was found to be the use of burlap sacks filled with sawdust. These were found to be light and easy to handle, would conform to any shape of surface, did not permit the concrete to escape, and formed a good, rough joint for bonding with concrete poured the next day.

One of the most troublesome problems in successful operation of a pneumatic placing system is the maintenance of elbows or curves in the delivery pipe line. On this job special elbows with a radius of 7 ft. were made up of manganese steel 1 in. thick. These elbows were supplemented by a manganese plate 1 in. thick bolted to the outer half of the elbow. When the elbow and plate were worn through a new plate was bolted to the lugs cast on the elbow for this purpose. This type of elbow gave good satisfaction and replacements were easily and quickly made. Ordinarily, one of these elbows would serve to line a mile of tunnel, which is considered unusually long service in this work. The included angle in these elbows was 22½ deg. and the flanges were continued 6 in. beyond the end of the curve.

The plant layout and method of conducting operations at Big Creek shaft were much the same as at Priest portal, except that the material was dropped

MATERIAL STOCKPILES AT PRIEST PORTAL
Enough sand and crushed rock was made from tunnel muck to line 20,500 ft. of tunnel and stored here before lining operations began.

575 ft. down the shaft. Belt conveyors delivered sand, rock and cement to the collar of the shaft, where the materials discharged into a 10-in. standard pipe. A gate at the bottom of the pipe controlled the flow of material so that it was loaded, a batch at a time, into cars in the tunnel. Only sufficient material for one batch was in the pipe at any one time. After the batch had been withdrawn from the bottom the signal was given to start another batch.

In some parts of the tunnel considerable amounts of water were encountered. At such points drain pipes and drip pans were put in, using the same method as employed on the Catskill aqueduct except that on the Hetch Hetchy job the pipes were not used later for grouting purposes but were left open as weepers. Using this method, there was no noticeable washing of the concrete anywhere in the tunnel. The only grout placed was in the timbered sections and where dry packing had been employed.

The tunnel-lining operations on the mountain division of the Hetch Hetchy project have been carried on by the writer as subcontractor, the general contract being held by the Construction Company of North America. The work as a whole is under the general direction of M. M. O'Shaughnessy, city engineer of San Francisco.

Water Supply Problem for the Future Chicago

Abstract of Paper Presented by John Ericson, City Engineer of Chicago, to the Western Society of Engineers, Feb. 19, 1925.

THE past rapid growth of Chicago, with its frequent and extensive annexations of adjacent communities, with generally obsolete and inadequate water supply systems, has made the water supply problem, at least as far as furnishing the required quantities is concerned, a more or less difficult one at all times. This can better be realized when it is considered that the area of the city in 40 years' time has increased from 36 to 205 sq. miles; the population from 640,000 to 3,000,000; the average daily pumpage from 80 to 845 m.g.d., and the average daily per capita consumption from 125 to 280 gal.

Notwithstanding continuous activities and the expenditure of millions of dollars for extensions, there has at no time been any real satisfactory service, either as regards the quantity or the quality of the water, especially when considering the standards set by other large lake cities and by the United States government as regards such service.

In view of this situation, as far back as 25 years ago as careful an investigation as conditions would then permit was made to ascertain what actual use was made of the great quantities of water pumped and what became of the excessive pumpage. These investigations showed that more than one-half of the pumpage served no useful purpose whatever, but was lost through plumbing and underground leaks, through wilful and other waste, and through slips in the pumps. This investigation also pointed to universal metering as the most practical remedy for this situation, and several reports and recommendations on this matter were presented.

The principal reason for this situation is that the city executives generally, and the city council in particular, have persistently failed to give any heed to repeated warnings or to act favorably on recommendations that have been made.

On the present metering plan future water consumption for Chicago in 1960, when the city is estimated to have a population of 5,000,000, is placed at 2,200 m.g.d. or 440 gal. per capita; with meters the total drops to 800 m.g.d., or 160 gal. per capita. The 1925 figures given are 840 m.g.d. and 280 gal. per capita. If 7,000,000 people are to be provided for, as some estimates indicate as the maximum population to be expected, the nominal pumping capacity will have to be nearly four times the present capacity of 1,100 m.g.d., and cost of required additions will aggregate $790,000,000, exclusive of filter plants. An average rate of 100 m.g.d. would have to be added every year for the next 35 years. It seems inconceivable that such an absurd policy should be continued; it may be assumed that metering will be an absolute necessity. The present 1,600 m.g.d. tunnel system need not then be greatly extended but obsolete pumping equipment would have to be replaced. Excess of expenditures over receipts by 1960 will be $67,000,000 without meters; with meters a surplus of $131,000,000 is estimated.

Regarding filtration it may be stated that notwithstanding the sewage-treatment plants under construction and planned by the Sanitary District, there will still remain objectionable turbidity and occasional pollution. The chlorine dosage has now been increased to the maximum permissible and held there. The dosage of 675,000 lb. of chlorine used in 1923 was nearly doubled in 1924. While filters cannot be built until the waste has been cut, tentative plans were submitted. Owing to the high cost of land near the various pumping stations the locations are at the shore line. The idea is to combine the plants with recreation piers. Tunnels, extended 10 miles into the lake so as to get to clear water in 50 or 60-ft. depths beyond wave action, are considered beyond the point of practicability from the physical or cost standpoint.

Suggests President Call Great Lakes Conservation Conference

Conclusions of Paper on "The Sewage Disposal Problem of Chicago" Presented to the Western Society of Engineers, Feb. 19, 1925, by George W. Fuller, Consulting Engineer and Chairman, Engineering Board of Review.

THE most important results of the studies of the Engineering Board of Review of the Sanitary District of Chicago do not concern engineering but relate to economics. The board summed up the chief engineering findings in the statement that the Drainage Canal afforded the wisest solution of the sewage-disposal problem of the district at the time it was built and that instead of becoming obsolete its value to the district has increased and it is also a national asset as the most costly section of the Lakes-to-Gulf Waterway.

The future requirements of Chicago as to sewage disposal demand faithful performance of the program set forth. In 15 to 20 years from now conditions can well be reviewed again. For the intervening period the Board of Review recommended: "That the district apply to the federal authorities for permission to divert from Lake Michigan an annual average of 10,000 sec.-ft. of water as measured at Lockport, for sanitary and navigation purposes, until such time as a re-appraisal shall indicate that the most beneficial use of the waters of the Great Lakes requires a reconsideration of the amount of such diversion."

As a quasi-national undertaking affecting navigable waters, the Drainage Canal is, to some extent, under the Corps of Engineers, U. S. A., through the Secretary of War. The federal statutes authorize the Corps to give due consideration to but part of the aspects of the canal problem. Some aspects come under the cognizance of the Department of State. All aspects are so important and the organizations interested in them are so large that each of these organizations, excepting the United States itself, is inevitably reluctant to invite the others to a conference, lest this be interpreted as a sign of weakness. As two federal executive departments are already concerned, probably the most satisfactory way to reach an equitable program for the conservation of the Great Lakes is for the President of the United States to call all the principal parties involved into a conference on the subject. Whether this is feasible or not is not for me to say, but I wish to leave the thought with you that problems of this kind have been carried a long way toward solution when all concerned have agreed that there are certain things upon which they are in accord and have clearly stated the reasons for disagreement upon the remaining things. Time and mutual fair play generally indicate how to overcome these disagreements that seem insurmountable until it is shown how small a part of the whole each item of disagreement really is.

Double-Deck Freight Terminal for Monon Line

Indianapolis Station of Unusual Design—Outside House Tracks at Upper Level—Team Tracks on Incline to Street—Reinforced-Concrete Construction—Freighthouse Operation

RECONSTRUCTION of the freight terminals of the Chicago, Indianapolis & Louisville Ry. (Monon Line) at Indianapolis, Ind., with the adoption of a double-deck freighthouse, has been made necessary by the comprehensive policy of track elevation which has been carried out at that city, so that with the main line elevated to the new grade of the union station the old freight facilities at the street level were in an inconvenient position and approached only by a temporary incline. The old terminal included an inbound freighthouse, 42x400 ft. and outbound house 49x305 ft., with four tracks between them. In addition there was a team yard with four tracks.

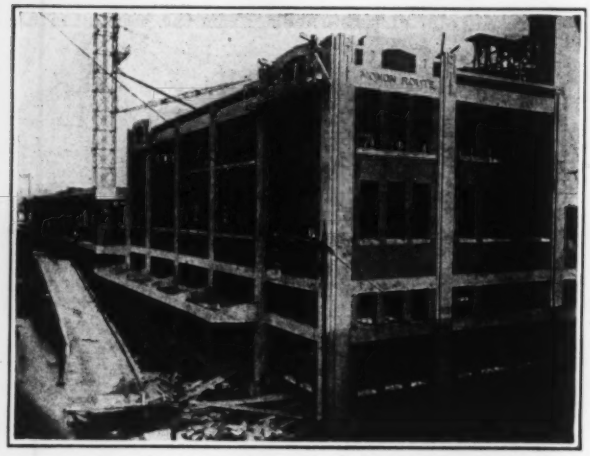


FIG. 1—DOUBLE-DECK FREIGHTHOUSE AND OFFICE BUILDING

Street and driveway side; tracks on upper level at right; offices on third floor. Temporary incline for trucks serving bins of concreting plant.

After an extended study of the situation in order to utilize to the best advantage the property available it was decided to construct a two-level or double-deck freighthouse to accommodate both inbound and outbound service, with a team yard in the rear. The lower deck serves teams and wagons while the upper deck serves tracks at the level of the elevated main line, which runs diagonally to the building. None of the tracks enters the building, as at the Detroit freight station described in *Engineering News-Record*, Aug. 7, 1924, p. 227. At the west end of the Monon freight station is a third story, providing ample accommodation for freight offices. The cashier's office is on the first floor. Since the rear of the building is against the fill of the elevated tracks the driveway on the other side has to serve for both inbound and outbound business, but the tailboard frontage is ample for a considerable increase in the peak of the outbound business, which comes in the afternoon. The new building is shown in Fig. 1 and a layout plan in Fig. 2.

Freighthouse Design—In the main portion the new building is 464½ ft. long and 46 ft. wide, but in order to give increased room for freight storage the width at the first floor is increased to 63 ft. by carrying one track and the platform of the second floor on a concrete structure parallel with but independent of the building, instead of extending the fill to the wall of the building proper, as originally intended. This arrangement is shown in Fig. 3. On the upper story also the width is increased to 54 ft. in the two-story portion, 366½ ft. long, by cantilevering the floor 8 ft. over the driveway, this projecting portion also serving the purpose of a canopy for the protection of freight. For the three-story portion, 98 ft. long, the 46-ft. width is maintained and an 8-ft. canopy protects the freight being handled at the doorways.

An 8-ft. trucking platform level with the second floor extends the entire length of the track side of the building and is protected by a concrete cantilever canopy. Beyond the building this platform widens out and forms a covered platform for trucking and storage of rough freight (see Fig. 2). In the building, the clear interior height under the cross girders is 14 ft., 12¼ ft. and 10½ ft. for the three stories respectively.

In structural design the building is of reinforced concrete and consists of three-column bents spaced 19 ft. 2⅛ in. c. to c., and having floor and roof slabs supported by longitudinal beams or stringers framed between the cross girders of the bents. The first floor is on a solid fill. Both first and second floors have a 5-in. slab and are designed for a 300-lb. live-load; the third floor has a 4-in. slab and is designed for a live-load of 100 lb. The roof has a 3-in. slab covered with felt, pitch and gravel roofing. In the office portion a suspended ceiling of plaster and expanded metal is placed below the roof beams.

All floor slabs, including the offices, have a 1-in. cement finish giving a smooth and hard surface strong enough to stand trucking and freight handling. Steel sash is used throughout. Along the driveway side of the house are openings 12 ft. wide and 9 ft. high fitted with rolling steel doors; a line of sash above the doorways gives good lighting for the middle part of the floor. A similar arrangement of doorways and sash is provided along the platform side of the second floor. Spread footings on a gravel formation constitute the foundations.

In the exterior walls, the surfaces of columns and spandrel girders are left exposed, the concrete being given a surface finish by rubbing with carborundum blocks and having colored tile inserts at the main street front. Red rough face brick is used for the spandrels and curtain walls. In the interior, the walls are lined with shale brick, which is left exposed; the concrete also is left exposed and in its natural color.

For carrying freight between the two levels there are four electric elevators 9½x16 ft., of 5 tons capacity and traveling at the rate of 75 ft. per minute. They are of the automatic type, requiring no attendants but being operated by the truckmen by means of push buttons. A micro-drive equipment brings the car to rest with its platform level with the floor, and until it is in this exact position the doors cannot be opened. For freight handling there will be four-wheel hand trucks and some

lifting trucks, movable platforms being used in connection with the latter so that the freight stacked on these platforms will not have to be transferred to the trucks, which will pick up the platforms bodily. On the first floor are four 5-ton platform scales for weighing freight.

East St. Bridge—At one end of the building the tracks and trucking platform are carried across East St. by a bridge 69 to 83 ft. wide consisting of three lines of concrete bents, which, with the abutments, carry two sidewalk spans of 13½ ft. and two roadway spans of 31½ ft. c. to c. Upon the concrete cap girders of the bents are lines of I-beams embedded in concrete and having a heavy slab upon which are the ballasted tracks elevated tracks to the team yard has a descending grade of 3 per cent, while the team tracks and driveways have a grade of 1.1 per cent running down to street level. All tracks are laid with 90-lb. rails; the turnouts have 15-ft. switch rails and No. 7 frogs. Massive bumpers of reinforced c ncrete are placed at the ends of the stub tracks, that of the first house track being anchored to the deck slab by bent rods. To the face of each bumper is bolted a striking block consisting of two short timbers separated by nests of car springs.

Freighthouse Operation—Traffic conditions, of course, are a factor affecting the size and layout of a freight station and must be co-ordinated with physical conditions as to size and shape of site available and the loca-

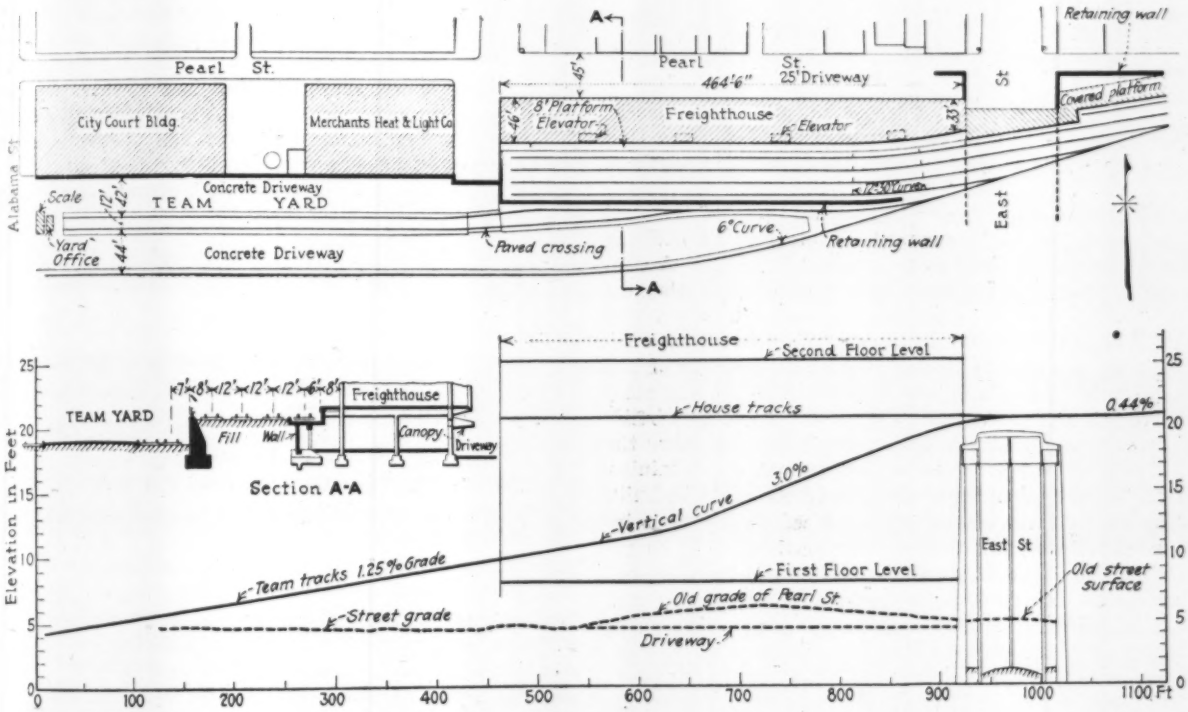


FIG. 2—INDIANAPOLIS FREIGHT TERMINAL; C., I. & L. RY.

as shown by Fig. 4. At the freight platform, the deck slab is raised to form this platform (see Fig. 4). This reinforced-concrete structure, designed for Cooper's E-60 loading, forms a continuation of the adjacent steel girder bridge which carries the team tracks of the C., C., C. & St. L. Ry. The concrete facia girders are paneled and have the name "Monon Route" in large letters formed by inserts of green tile. The canopy roof along the bridge is also decorated with tile inserts.

Track Layout—Four tracks spaced 12 ft. c. to c. serve the freighthouse and platform and have a combined capacity of fifty-five cars. The cars are spotted with their doors opposite each other to allow of through trucking from the platform. The first of these tracks rests upon a concrete slab which is supported independently of the freighthouse structure and is designed for an E-60 loading with 50 per cent allowance for impact. The other three tracks are on a solid fill which is held by a retaining wall along the side of the team yard. These team tracks, with a combined capacity of 35 cars, are spaced alternately 12 and 44 ft. c. to c. and are served by two paved driveways. The lead from the tion of street approaches. Including the house and team tracks the present business of the Monon Line terminal at Indianapolis averages 30 cars inbound and 20 outbound daily, with a daily tonnage handled of 350 tons inbound and 220 tons outbound. The peak of the outbound business, which a freight station must be designed to handle efficiently, comes just before 4 p.m., when the house is closed and no more shipments are accepted that day.

With inbound business, loaded cars received from local stations are usually spotted at the freighthouse during the night. The merchandise run from Chicago reaches Indianapolis at 7 a.m.; these cars are spotted at about 8:30 a.m. and made empty by noon. Usually the same cars are used for loading outbound freight, foreign cars being loaded in the direction of home and other loading being taken care of by system cars. The house tracks are switched during the night and at noon. It is planned to have all inbound freight stored on the first floor as soon as it is unloaded. Outbound freight will be taken to the second floor as soon as received and will be loaded into cars at once, or stored on this floor if

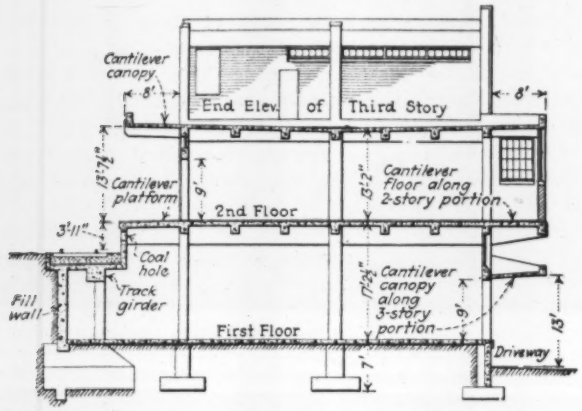


FIG. 3—CROSS-SECTION OF FREIGHTHOUSE

Note extra width of first floor and cantilever widening of second floor.

cars are not available. Cars on the four house tracks are spotted with their doors opposite each other, so that freight can be trucked through them, portable panels or gangways being placed to connect the cars.

Construction Methods—In building this new terminal the work had to be planned to interfere as little as possible with the business of the old facilities. A temporary outbound platform was built between Alabama and New Jersey Sts., and the old outbound house was utilized as the inbound house, served by one track only. This arrangement gave room for the erection of the new freighthouse and one elevated track on the reinforced-concrete structure in the rear. After this building was completed and put in service in December the old building was wrecked so that the concrete retaining wall for the other three elevated tracks could be built. The fill for these tracks will be placed during the winter. In the spring the one surface track will be removed, the East St. Louis bridge extended to its full width and the team yard graded. The retaining wall on the approach east of East St. (Fig. 2) was built in

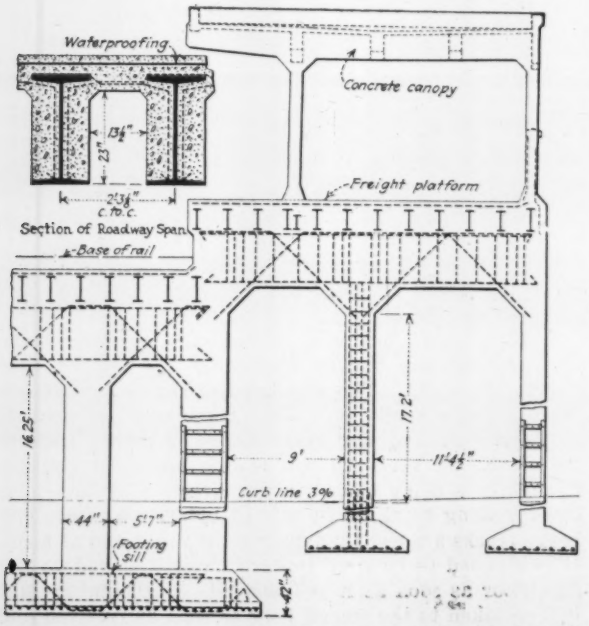


FIG. 4—EAST ST. BRIDGE CARRIES FREIGHT PLATFORM

1922 and enough fill was placed for the inclined connection between the old surface terminal and the elevated tracks of the Indianapolis Union R.R., over which all roads pass through the city.

A concrete mixer with overhead storage bins was erected in Pearl St., alongside the site, as shown in Fig. 1. Cement was delivered by cars on a spur track at one side of the street. Sand and gravel were delivered in motor trucks, which ascended an inclined roadway to dump into the elevated bins. A steel hoisting tower with boom chuting system delivered the concrete to the forms or to hoppers from which it was distributed by buggies.

Engineers and Contractors—This new terminal was designed and built under the direction of A. S. Kent, chief engineer of the Chicago, Indianapolis & Louisville Ry., with E. M. Graham, principal assistant engineer, in charge of construction. The freighthouse, with the combined retaining wall and elevated track structure in the rear, was built by Thompson & Binger; the East St. bridge and platform and the retaining wall along the team yard were built by the Mead-Balch Construction Co.; both of these are Indianapolis firms. The total cost will approximate $500,000.

Design of Reinforced-Concrete Stone Bins

Stresses Present Not Found in Other Structures of Same Type—Additional Slab Thickness Allowed for Wear from Rock

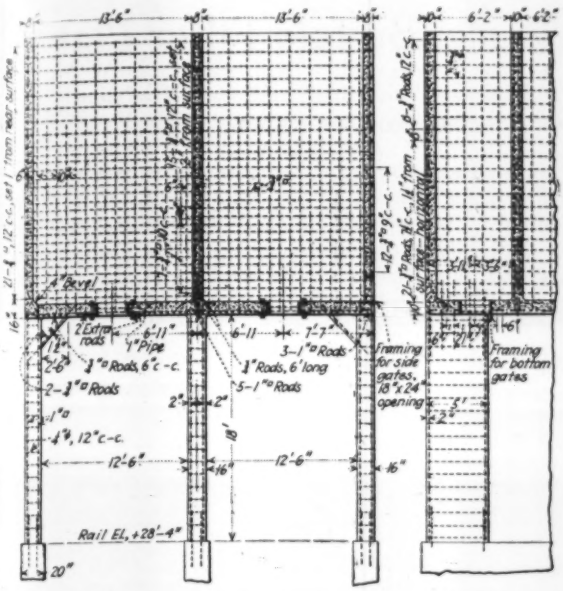
BY J. M. TAGGART

Taggart & Perry, Consulting Engineers, New York City

THOUGH the use of reinforced concrete for permanent rock storage bins is becoming more or less standard practice, there are certain considerations in design which make this class of construction one of particular interest. Storage bins are subject to heavy loads that can be closely forecast, but, in addition, the shock due to the discharge of material into and from the bins sets up added stresses that cannot be so accurately figured, but which should be accounted for in the design. Also, the possible wearing away of the concrete surface due to the flow of rock is a further consideration, especially as the surface on the side toward the rock is the highest stressed material. In view of these facts it is advisable to enlarge factors of safety above those used for structures where the assumed maximum load is a possible but not a probable one.

Some facts concerning the design and construction, therefore, of the stone crushing plant of the Lime & Stone Products Corporation, located near Hamburg, New Jersey, present some interesting data.

The bins shown in the accompanying photograph were figured for steel and concrete stresses of respectively 12,000 and 600 lb. per square inch. An allowance of about 1 in. was left above the computed depth for wear. In other words, the surface of the concrete on the bin side was computed as 1 in. inside the actual surface. In the walls reinforcement was placed both vertically and horizontally to distribute the heavy stresses at bottom upward. Full value of such distribution could not be allowed because of differential deflections. A considerable increase in strength over simple horizontal reinforcing is realized while at least half of the vertical re-



DETAILS OF BIN AND PIER REINFORCING

inforcing used would in any case be needed for bonding and prevention of shrinkage cracks.

The walls of the bins were bonded into the floors and reinforcement was so placed that they acted as floor-beams. An analysis of the stresses showed that no additional concrete would be needed. This followed from the direction of the stresses as well as the presence of unstressed concrete in the walls. The result was an 8 per cent increase in the capacity of the bins for the same height and clearance over the tracks. There was also a reduction in formwork and the amount of material required.

Drilling and excavation on the location of the bins developed a hardpan formation varying somewhat in sustaining power. The form of foundations used made allowance for this variation. Thus in the main the foundations consist of three parallel beams. Each beam carries four piers and is reinforced so that the pier loads are distributed and that settlement of a single pier cannot occur without rupture of the beam. It was believed that this arrangement together with the low bearing stress used would guard against injurious settlement.

Because of the retaining-wall effect on the foundation beams due to the trains passing under the bin, two transverse walls were installed to brace and tie in the main foundations. The form of foundation used required some concrete and reinforcement but less formwork than isolated piers. A careful examination some time after the construction had been completed showed no cracks in the piers or bins.

REINFORCED-CONCRETE STONE-CRUSHING PLANT

The mixture used for the bins consisted of one part cement, two parts screenings and one part sand, five parts of ¾-in. stone. The stone and screenings were both crushed hard limestone. Experiments were made to ascertain to what extent screenings could be substituted for sand, the object being that screenings were on hand and sand had to be hauled in from some distance. The first tests of mortar samples made up from screenings showed a high strength and a dense aggregate. Extension of the tests developed two dangers in the exclusive use of screenings—(1), occasional dust accumulation prevented a thorough distribution and wetting of the cement, and (2), where the screenings were washed by rain there was not sufficient fine material and the aggregate was porous, under strength and evidently would not flow readily around reinforcement and into corners.

The addition of one part sand in place of screenings corrected both defects and gave a mixture that proved entirely satisfactory. For the bin floor and piers a higher proportion of sand was used. For heavy foundations 4- and 6-in. stone was added to the concrete.

In building the crusher house reinforced concrete was used up to the ground level for all building construction except where the rock of the excavation served as walls. Excavation is filled normally to a height of 25 ft. above the basement of the crusher house. The floor was laid on and tied to the rock, the walls were reinforced to withstand the hydraulic pressure and made dense to keep the seepage down to a minimum. This density was increased by the addition of approximately 5 per cent hydrated lime. In addition, a heavy coat of bitumastic composition was put on the outside of the walls. The seepage through the walls has proven very small. The concrete mix used for the crusher house and conveyor tunnel was the same as for the storage bins.

Electrification on French Railways

Three of the five leading French railway companies are pushing the work of electrification on certain parts of their lines; the programs for the Southern, the Paris & Orleans and the Paris, Lyons & Mediterranean being for nearly 2,000 miles each. On the Southern Ry. one section of 190 miles is completed, one of 146 miles is under way, and with other sections, is to be completed in 1926. This company is building sixty electric locomotives at its own shops. The Paris & Orleans has the work completed on about half of its line from Paris to Brive, 312 miles, and has three other sections aggregating 400 miles under way. Steam power plants will be used for one 167-mile section, all the others being served by hydro-electric plants. It has 200 electric locomotives and 80 motor cars under contract. The Paris, Lyons & Mediterranean Ry. has work in progress on seven sections aggregating 600 miles, exclusive of 200 miles of suburban and local lines around Paris. The Northern Ry. and Eastern Ry. have not yet begun work on their projects. On the State Railways the electrification is limited to the Paris lines.

Substructure Construction Methods: Buffalo Filter Plant

Water Bearing Foundations Made Safe by French Drains — Traveling Cableways Distribute Concrete in Five-Yard Buckets—Job Haulage System Notable

SUBSTRUCTURE construction for the new filter plant of 160 m.g.d. capacity at Buffalo, N. Y., involved the considerable volumes of 380,000 cu.yd. of earth excavation, 7,000 cu.yd. of rock excavation, 110,000 cu.yd. of earth embankment, 110,000 cu.yd. of backfill, 60,000 cu.yd. of concrete and 4,000 tons of reinforcement. The area, embracing all but the minor extremities of the structures, was about 1,000 ft. square. About a quarter of the areas was under water of a portion of the river cut off by a dock wall outside of which, at one end of the area, there was draft for scows and tug boats. On the opposite side of the area from the river, were railway connections. Access was available, therefore, both by boat and by train. These various features combined to present an interesting construction problem.

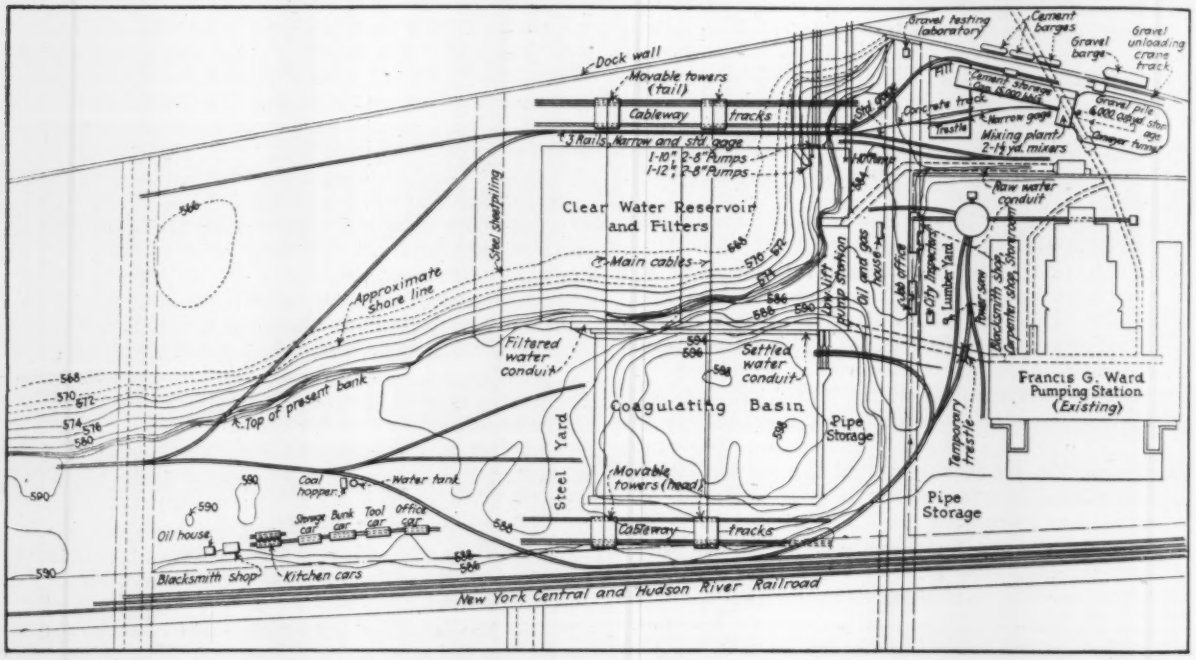


FIG. 1—CONSTRUCTION LAYOUT FOR BUFFALO FILTER PLANT

Construction Planning — Emplacement preparation was virtually a controlling condition in planning construction. With existing rail connections as shown by Fig. 1, and also an available waterway, getting in materials was easily possible with no lack of unloading and storage room. The compact structure arrangement left open, too, a choice of several plant types and arrangements. There was indeed no condition offering an obstacle except getting ready the emplacements, and here getting rid of the water so that the concrete could be placed in the open on dry foundations was the main task. It was virtually a cofferdamming operation.

Referring to the contours on Figs. 1 and 2, it is noted that a considerable depth of excavation was necessary to get the required depth for the coagulating basin and to get to rock for the footings. To use the excavated material for a fill around the submerged clear water basin site was an obvious thought. It made the desired fill between the reservoir and the dock wall and on that side it provided the required cofferdam wall. Backing up a line of steel sheetpiling it also provided a south wall for the cofferdam. Of equal importance, the fill behind the dock wall gave space for construction plant. Fig. 2 shows how the space was thus utilized.

Besides solving the paramount problem of emplacement preparation, this general plan also fitted well with the conditions of access. Niagara River gravel, an excellent material, was the logical source for concrete aggregate. Direct shipment by barges to the nearest point on the dock wall line where the draft was sufficient was possible. Also cement could be brought in by boat. With a mixing plant, stockpiles and cement house on the dock at deep water, aggregate and cement could be unloaded directly to storage from the barges and concrete could be delivered by railway along the dock wall fill for rehandling to the structure. For the other materials, lumber, reinforcing steel, pipe and fixtures, there were the railway connections with ample land east and north of the structures for unloading and storage. Also by thus dividing delivery no material handling process obstructed another, and in particular, a clear way was afforded for the important operations of concrete supply.

With delivery arranged as described, cableways seemed the logical means of distribution. They could handle all materials—concrete, forms, steel and pipe—and they could pick up any of them, except concrete, from where they were prepared for installation. To

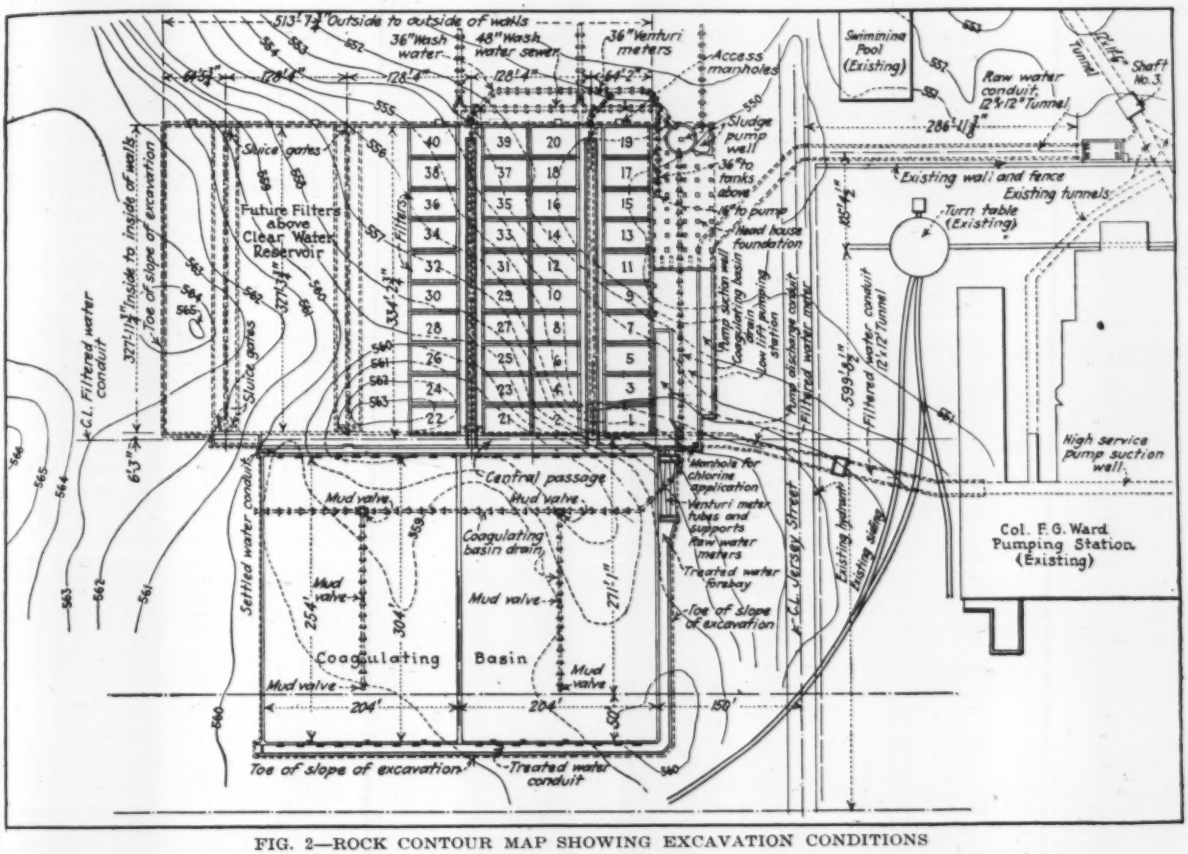


FIG. 2—ROCK CONTOUR MAP SHOWING EXCAVATION CONDITIONS

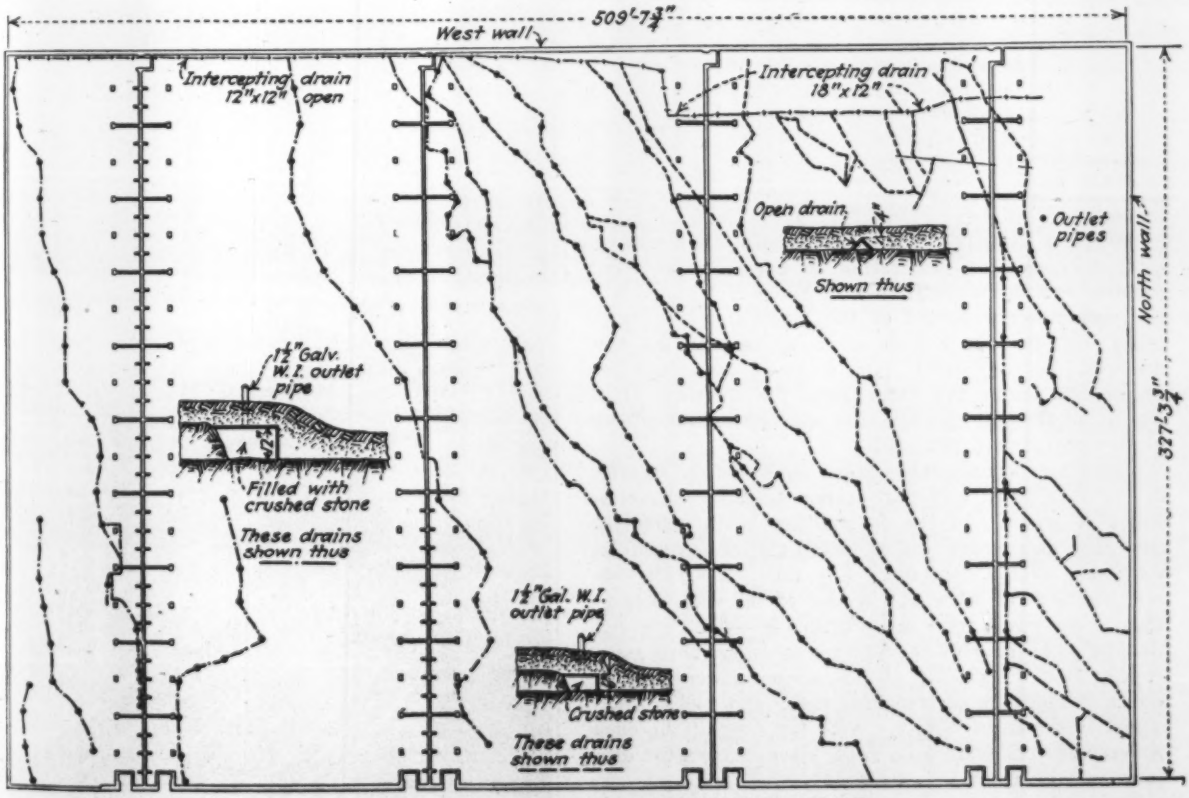


FIG. 3—FRENCH DRAINS FOR FOUNDATION DRAINAGE

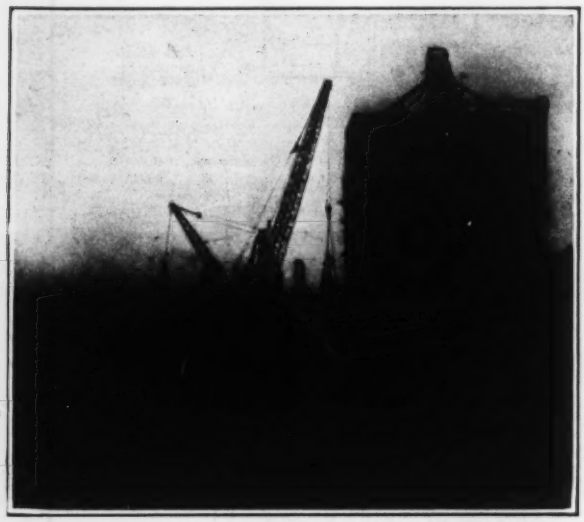


FIG. 4—UNLOADING AND CONCRETE MIXING PLANT

meet the schedule and also leave one free for the major operation of concrete distribution, two cableways were installed. A more particular description of them is given further on.

Excavation and Drainage—The excavation consisted largely of earth from the coagulating basin site and of a minor volume of rock mostly from the bottom of the clear water reservoir emplacement. All this excavation except some part kept for backfill went into the embankment behind the dock wall and largely west of the clear water reservoir. This called for rather long haul and standard-gage service tracks were laid down as shown by Fig. 1. About two miles were required. The railway equipment was three 50-ton locomotives and 40 12-cu.yd. dump cars. Digging began Sept. 26, 1922, and by June 25, 1923, it was far enough along for concreting and thereafter the excavation was merely kept well ahead.

There were no particular features to the earth moving. The digging and loading were done with two 2½-cu.yd. draglines, and, for trimming, by a ⅜-cu.yd. steam shovel equipped as a dragline. Until the site was cleared enough for concreting to begin, about eight months, excavation continued 24 hours a day. It was the cold weather period of the year, and, the earth being wet, the dump froze about as fast as the new material was deposited. On occasion dynamite was required to loosen the dump tracks for shifting. This was about the only obstacle that winter weather offered to straightforward procedure.

There was considerably more construction interest in the rock work and particularly that for the clear water reservoir. In the coagulating basin about the only rock excavation was to install the drains and for wall and column footings. For these the rock was removed to solid ledge and in case of the wall footings 18-in. steel dowels were set in drilled holes and grouted. Generally the floor of the basin was everywhere above rock so that the placing of mud drains under the floor was a simple task of trenching earth and rock. Their layout is shown by Fig. 2. With the floor of the clear water reservoir resting on rock, however, greater difficulty was involved.

The rock contours as shown by Fig. 2 indicate a northwest dip. As a fact the rock, flint and limestone formation, is in layers of 6 in. to 24 in. which step down toward the northwest corner of the reservoir emplacement and carry considerable water. This condition upset the anticipated task of leveling off the rock and putting on a 4-in. concrete floor. Instead, a rather elaborate arrangement of under-drains had to be put in and the water kept down in order to lay floor concrete. This in some places also became 24 to 28 in. thick. The drains vary in size and are irregular in location as shown by Fig. 3, but all are French drains and all lead to an interceptor and sump which is kept emptied by pumping. This drainage, vital as a construction device, is also a permanent necessity to prevent upward pressure on the concrete floor. The construction pump layout is indicated by Fig. 1. The plant has of course varied to some extent but on Oct. 15 it consisted of two 12-in., two 10-in., three 8-in., two 6-in., one 3-in. and one 5-in. centrifugal pumps, all but one belt-driven from electric motors.

Placing Concrete—Except that the plant was notably well devised, the concreting methods were not out of the ordinary. Fig. 1 shows the plant layout and Figs. 4, 5 and 6 are plant and construction views. Concreting operations sorted themselves naturally into: Unloading and mixing, transportation, distribution and subsidiary processes such as formwork and reinforcement fabrication.

To find the necessary deep water for boats the mixing plant had to be located about 1,000 ft. north on the edge of the dock. It was placed close to the edge so that a railway track along the dock would give free swing to a locomotive crane unloading from barges directly into stock. The gravel was handled by clamshell into a 6,000-cu.yd. stockpile over a tunnel. As shown by Fig. 4 the cement house (15,000 bbl.) was parallel to the dock and had hatches in the roof. The cement bags on deck were loaded into rope nets, lifted by the crane and dumped into the roof hatches. There was

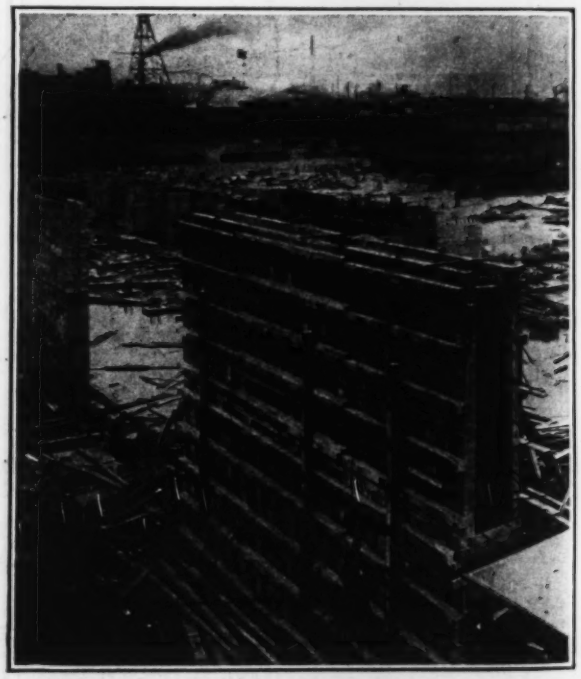


FIG. 5—WALL FORM SECTION BEING ERECTED

no piling in the cement house, the bags lay as they fell.

Movement from stock to the mixing plant, which was in line between the cement house and the gravel pile, was as follows: Under the gravel pile, about 80 ft., was an 8x8-ft. tunnel in which ran a 24-in. belt conveyor with a capacity of 200 tons an hour. A 15-hp. motor operated the belt which discharged into a bucket elevator 85 ft. high with a capacity of 250 tons an hour. The elevator was operated by a 40-hp. motor and discharged into two 400-cu.yd. mixed-aggregate bins over the mixers. As it might be necessary to add either sand or gravel to obtain the proper grading of mixture, the elevator discharge chute was arranged so that when necessary a trap door was opened, permitting the elevator to discharge onto a screen which separated the sand and stone and discharged them into separate bins. Ordinarily the chutes discharged mixed aggregate into either of the 400-cu.yd. bins. From the bins the aggregate was gated into measuring hoppers on the charging floor.

Cement was raised to the charging floor by a freight elevator and transferred horizontally by jack-lift trucks. A number of 27-bag platforms were provided so that no waiting to load was necessary. With the platform resting on the floor, loading was easy and then the trucks could be pushed under and the load jacked up for moving. Under the heavy loads, however, the trucks cut up the wood floors and so the runways were covered with ¼-in. steel plate. The measuring hoppers on the charging platform fed to two 1½-cu.yd. tilting mixers which discharged into a common 10-cu.yd. hopper.

A 36-in. gage track ran parallel to the dock wall from the mixing plant to and along the west wall of the clear water reservoir. On this service line 3½-ton gasoline locomotives hauled flat cars carrying 5-cu.yd. bottom-dump buckets. The size of the buckets is notable but they were readily handled by the cableways and, more particularly, were not found too cumbersome for pouring narrow walls and small volumes of concrete. Some eighty 6-in. walls were poured with these 5-cu.yd. buckets.

Virtually all concrete was distributed and placed by cableways. These also handled forms and reinforcement and much of the cast-iron pipe. They had spans of about 900 ft., and were supported by steel towers traveling on tracks parallel to the east and west walls of the structures. About the only novelty is the steel traveling towers. These are 85 ft. high and were designed so that 20 ft. could be added. The cableways were steam operated. For traversing there was a single-drum engine on each tower and a 40-hp. vertical boiler on each tail tower—the traversing speed was 150 ft. a minute. Scotch marine boilers and 12x12-in. engines on the head towers operated the carriage. The carriage speed was 1,500 ft. and the hoisting speed was 250 ft. a minute. The towers and cableways were designed for 15-ton working loads and made individual lifts as great as 28 tons.

FIG. 6—REINFORCEMENT FOR FILTER GALLERY

The concreting operations presented only ordinary features. The walls varied from 4 to 30 ft. in height and were poured in most instances to full height. In narrow walls where tamping or rodding was difficult, consolidation was secured by vibrating the forms with air hammers. Where practicable the forms were made in panels of 2-in. shiplap nailed to 4x6 studs and 6x8-in. waling pieces. The form panels were of various sizes up to 30 ft. high and 60 ft. long. They were tied together through the wall by bolting; the bolts ran through iron pipes 2 in. shorter than the wall thickness. These pipes remained in the concrete and when the bolts were pulled the holes were plugged and concreted. About 1,250 M. ft. b.m. of lumber was used

in the formwork, including the staging for the roof forms which were built in place. The circular column forms were steel. Fig. 5 shows a wall form panel.

There were about 4,000 tons of reinforcement, which was handled by the cableways. About the only exceptional feature was the extensive use of acetylene torches for cutting the steel. The extent of reinforcement in especial instances is indicated by Fig. 5.

Besides the main filter structures, there were the two main conduits and the tunnel connections which involved minor but very troublesome operations because of water. One of these notable shaft building operations is described in a separate article.

All engineering with respect to design and construction has been in the hands of a special force employed by the city and organized and directed by George C. Andrews, water commissioner and engineer of the filtration division whose principal assistants have been C. D. Parsons, J. L. Ames and S. E. Roof. Fuller & McClintock of New York are consulting engineers.

Special contracts were let for the several parts of the work. The largest involving about $2,000,000 for the substructure described in this article was awarded to Thompson-Starrett Co., New York City, with N. M. Loney, vice-president, in charge. E. V. Winell was general superintendent. Other contractors were Jarrett-Chambers Co., Pitt Construction Co., Chapman Valve Co., Michigan Valve Co., Rensselaer Valve Co., U. S. Cast Iron Pipe Co., Bowler Foundry Co., McWane Cast Iron Pipe Co., and Dayton-Dowd Co.

[*This is the second article on the Buffalo filtration plant; the first appeared Feb. 19, p. 322*—EDITOR.]

Behavior of Débris-Carrying Rivers in Flood

What Happens to Stream Bed Material in Southwest Rivers and How Necks in Loops May Be Successfully Cut to Prevent Levee Destruction

BY F. N. HOLMQUIST
Of Holmquist & Becker, Engineers, Phoenix, Arizona

OBSERVATIONS of certain rivers, particularly the Gila and its tributaries and other streams of a like character in flood and at other times have led the writer to form certain general conclusions regarding the behavior of such streams which may be of value to the engineering profession and help to avoid some common mistakes. Study of a river bed after flood cannot help but impress the observer with the havoc wrought in certain places while only a few hundred feet away such unstable things as sand bars covered with a few weeds are still intact. These phenomena, striking as they are, can be readily explained by theories and formulas which are familiar to the engineering profession but which, so far as I know, have never been followed to their logical conclusions in the case of rivers in flood.

In this discussion only general principles are considered though practically every problem is complicated by many factors which cannot be discussed briefly. No new principles are involved and no quantitative investigations such as have been undertaken by the U. S. Geological Survey and other investigators have been made, but an attempt is made to reconcile conditions observed by the writer with well-known principles. To do this it is only necessary to follow to their logical conclusions a few fundamental principles relating to running water and the transportation of débris by running water. For the present article it is necessary to quote only two such principles and those in a general way, viz.: (1) The carrying capacity of débris by running water as regards quantity increases with increase of velocity and decreases with decrease of velocity. (2) The weight of individual particles which can be moved or carried by running water under given conditions varies as the sixth power of the velocity of the water. It is assumed in this article that water moving 3 ft. per second (average velocity in a vertical section) will move particles weighing 0.04 lb.

To illustrate some of the points discussed cross-sections of the water in the Verde River near Fort McDowell are shown. These cross-sections were platted from notes taken by the Salt River Valley Water Users' Association in measuring the flow of the stream. However, the maximum flow shown by these sections is only 15,000 sec.-ft. while floods in this river frequently carry as much as 100,000 sec.-ft. or more. Also the gaging station is located where the river runs between rock banks and is confined to a comparatively limited width whereas the portions of such rivers which are hard to deal with are in open country with silt banks on one side or on both sides. Actual cross-sections of a stream of this character in open country during a large flood are not available. Gaging stations are naturally located where the stream is confined, and, in the case of the stream referred to, major floods are not measured at the gaging station but are estimated at Granite Reef Dam several miles below and after the Verde River has joined Salt River. The task of measuring such a cross-section would be extremely difficult and I know of no case where it has been attempted.

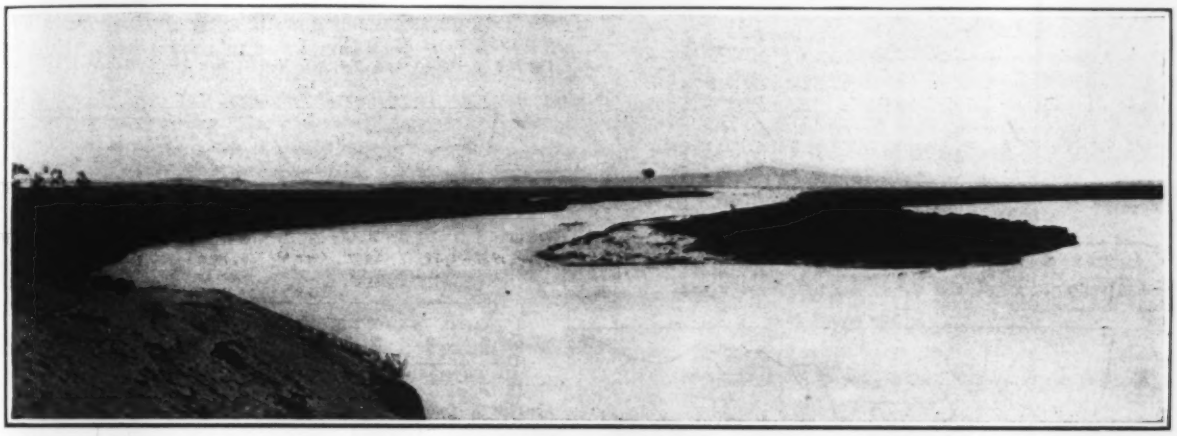
Channels in Southwestern Rivers—Rivers of the Gila type differ so much from streams in the eastern and middle western portions of the United States that some of their distinguishing characteristics should be noted. These streams have their source in the mountains and plateaus through which they have eroded deep canyons. Naturally they are confined to limited widths in this part of their course and as a consequence floods attain considerable depth. The gradient is also steep; a fall of 10 to 20 ft. or more per mile being common. As a consequence their velocities are exceedingly high. During heavy rains a large amount of débris is washed into the channel which is transported downstream by the current. Where these streams emerge from the mountains they spread out to greater widths and have shallower depths and slower velocities, thus depositing a portion of the burden picked up in the mountains. The tendency here is for the river to build up its bed

and therefore be located on top of a ridge. This is the case in some instances but is usually offset by the more rapid building up of the adjacent ground by tributaries and by talus from surrounding mountains. The resultant stream in the open country is generally one with a steep grade though not so steep as in the mountains. The river bed usually consists of fine sand and silt. Gravel and even coarse sand are uncommon, especially near the surface. The material composing the banks and surrounding country is in general fine soil and offers but little resistance to erosion.

Under these conditions the water in the river always carries all the burden it is possible for it to carry at the velocity at which it is moving, no matter what that velocity might be. If the velocity increases it picks up more burden, if it decreases it drops the excess.

Scour—Under ordinary conditions very little water is flowing in these rivers; frequently they are dry. Always a channel exists, usually very shallow, where the water is flowing or where it last flowed. Consider such a river while it is dry, the main channel being about a foot deep. The channel swings from bank to bank. A rise of 2 or 3 ft. on a fixed gage will be sufficient to cover almost the entire river bed which might be a mile wide or even more. Water comes down the river and follows this winding channel. Before it overflows it has risen a foot on the gage and has sufficient velocity to move the sand in the bottom and has altered the shape of the cross-section, some parts being deeper, others shallower. At one more foot on the gage it covers the ground a foot deep alongside the winding or main channel but on account of the scour that has already taken place in the main channel it is now much deeper there and is moving swiftly. The high velocity in the main channel results in deeper scour there so that instead of being only a foot deeper than the adjacent ground it is now 3 or 4 or 5 ft. deeper and is well defined and well established. The water continues to rise until the entire bottom is covered. This, of course, results in higher velocities throughout the stream but added to the previous high velocities in the main channel makes exceedingly high velocities there. Since the weight of individual particles which can be moved varies as the sixth power of the velocity, scour in the main channel is not limited by layers of gravel or small boulders but continues through them possibly uncovering a layer of finer material underneath and stopping only when it reaches material so coarse as to resist further scour.

In practically all cases the main channel swings from bank to bank. The water over the remainder of the river bed moves downstream slowly as compared with the velocity in the main channel but nevertheless at velocities that would ordinarily produce scour. Whether it scours or not however, does not depend so much on its absolute velocity but on whether its velocity is increasing or decreasing. Since the main channel swings from bank to bank and since all the water in the river is moving downstream it follows that the different particles of water take turn about being in the swift moving main channel and then in the more quiet water alongside. The result is that materials are picked up in or along the sides of the main channel, carried a short distance down and across the stream and deposited where the velocity is slower. In this manner the main channel tends to become deeper and deeper while the submerged ground alongside becomes higher and higher.

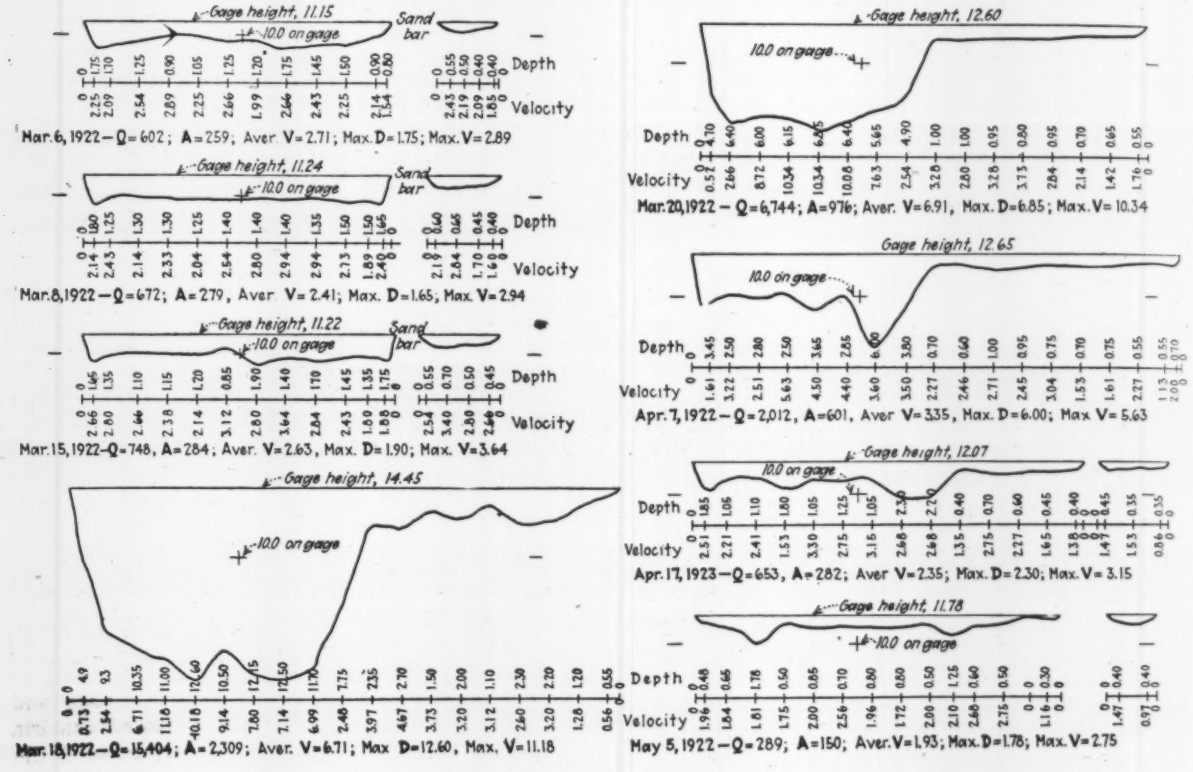


TYPICAL BEND IN COLORADO RIVER NEAR BLYTHE, CALIF.
Neck of land in this bend, which is not a major one, is 100 yd. wide, subject to overflow and composed of sand and silt. River carrying 50,000 sec.-ft.

In the main channel the greater depth, small at first, produces a higher velocity which in turn scours down to greater depths resulting in still higher velocities, etc. In major floods this process continues until material is reached which even the highest velocities will not move. In many cases, far more than is generally realized, this is bedrock. If water moving 3 ft. per second will move pebbles weighing 0.04 lb., then water moving 15 ft. per socond, or five times as fast, which is not uncommon, will move stones weighing 0.04 times the sixth power of five or 625 lb. Thus it can readily be seen that strata frequently considered the maximum limits of scour are by no means the limit. It follows also from the foregoing that a layer of boulders of a certain size is more likely to be the maximum limit of scour when found near the surface than it would be if found at considerable depth.

At Tempe, Ariz., a reinforced-concrete arch bridge spans Salt River (see *Engineering News*, March 28, 1912 [Vol. 67], p. 578). The second pier from the north end, pier 9, sets in the main channel of the stream and as originally constructed rested on two steel cylin-

ders which were sunk to bedrock and filled with concrete. Bedrock at this point is 24 ft. below the low water bed of the stream. In November, 1919, during a large flood this pier settled about 6 in. After the flood subsided careful observations were made but no further settlement occurred until February, 1920, when another large flood resulted in a further 6-in. settlement. During the second flood the quantity of water flowing was larger but the actual elevation of the surface of the water was more than a foot lower. The foundation was subsequently reinforced by the addition of four cylinders and no further settlement has occurred. While actual proof of the cause of the settlement is lacking there can be no doubt that at this pier the river scoured to bedrock. In fact, attempts to measure the depth of the water during the flood indicated that such was the case.



VARIATIONS IN STREAM BED PROFILE THROUGH TYPICAL FLOOD PERIOD

Possibly a layer of sand or gravel was left in the bottom of the cylinders when they were filled with concrete, and when the river scoured down to bedrock this material escaped allowing the bridge to settle. Or it is possible that the concrete at the bottom of the cylinders was crushed as suggested in the criticism of this bridge published in *Engineering News*, Vol. 67, p. 936 (May 16, 1912), but continued to support the load as long as it was confined and failed to do so when its lateral support was gone. At any rate no explanation has yet been suggested that did not presuppose scour to bedrock. In this connection it is worthy of mention that the stabilizing effect of the material composing the river bed during low water is replaced by powerful and highly destructive forces during floods.

Another result of deep scour in the main channel is to so increase its carrying capacity that the elevation of the surface of the water is lowered even though the volume of water is not diminished and the depth over the remainder of the river bed is decreased thus causing slower velocities, further deposition and still shallower depths over that portion of the river. Should such a river continue in flood for an indefinite time, and carry a constant amount of water, no matter how great so long as it does not find a new outlet, that water would eventually all be flowing in a well-defined channel while the ground alongside would be covered with sediment to a level approaching that of the surface of the water. Reference to the cross-sections of the Verde River as well as personal observations bear out in a general way the foregoing.

While rivers of this character usually have a very wide bed a major portion of the water, even in large floods, flow in one main channel which is comparatively narrow. Deep scour is confined almost entirely to that channel but in that channel is very deep. This channel usually changes its location only by accretion but sometimes by avulsion. The curves are usually along the banks which unless protected are cut away, successive curves being connected by a fairly straight channel running diagonally across the river bed from bank to bank.

In many cases railroads cross such streams on pile trestles which frequently wash out. Losses from this source might be materially reduced and the damage more quickly repaired if such trestles were so designed that if one section fails it will easily separate from the rest. The writer once saw 1,000 ft. of trestle go out when only 200 ft. would have gone had it not been that the rails and stringers holding together pulled the rest of the structure with it. Such a design should present no great difficulties. As usually designed at present there are three stringers on each side with joints stag-

gered making three continuous stringers over each bent, two stringers on one side and one on the other. At intervals of 100 ft. all stringers could be cut at the bents thus leaving only the rails to hold the deck together. The rails might also be laid with joints at these same bents with possibly a special design of joint which would fail with a strong side pull without diminished capacity to support vertical loads.

Engineering Work to Change Channel—Attempts are frequently made to straighten rivers by making cuts across bends. If work of this kind is undertaken it should be done during low water when the entire flow of the river can be turned causing the old channel to fill up and the new one to scour. Usually it is difficult to accomplish anything with this kind of work during high water for the main channel is so deep and so well established that excavations are too small to be of consequence and fill up instead of scouring deeper. If, however, such work is undertaken during high water the excavations should be started from the lower end, draining off the water which is fairly quiet and which, therefore, has the greatest capacity to pick up new burden. In this way a grade retrogression may set in, moving upstream until it again meets the main channel and may be of sufficient capacity to carry a considerable part of the water, thus slowing it down and causing deposit in the old channel and further scour in the new. Sometimes this happens of its own accord and a small amount of work might materially hasten the process.

In the summer of 1922 the Colorado River, during its annual rise, broke, or rather cut through a levee near Blythe, Calif., inundating a large area of cultivated land surrounding and including the town of Ripley. The river in this locality winds from bank to bank, the distance across the bends on either side being less than half the distance around by way of the channel. Engineers and other officials of the irrigation district, as well as people generally, believed that by making cuts across these bends on the Arizona side while the river was in flood the river could be straightened and would naturally follow a series of cuts connecting successive bends. Strenuous objections to such work were at first made by officials and citizens of Arizona but in view of the gravity of the situation objections were waived during the period of the emergency. The local engineers of the district were confident that four or five days' work would be sufficient to straighten the river at each bend and at once went to work. However, nothing was accomplished during the flood. Subsequently, under the direction of an engineer sent by the different bond houses and banks which had invested in securities to finance former levee construction, when the water had receded an excavation was made across one of the bends and when completed a temporary dam was thrown across the main channel forcing most of the water into the newly excavated channel. This work was completed just in time for the annual rise in 1923 and according to reports of engineers acting for the district was entirely successful, rapidly scouring to such proportions that it soon took the full flow of the river.

When a river breaks through its levees or takes an entirely new course the velocity of the water in the river (old channel) below the break is immediately slowed down causing it to deposit a portion of its burden. This decreases the depth of the water by raising the bottom which in turn slows down the velocity still more causing still further deposition, etc.

It is believed in general that engineers underestimate the depth of scour and over-estimate the width of scour. However, the main channel where scour is deep is constantly changing location and might at any time be anywhere in the river bed. It is believed that increased capacity of such rivers can be better provided by confining the river to a limited width rather than by allowing it to spread out indefinitely.

Power Development Policy for Pennsylvania Outlined

Giant Power Survey Board Proposes Huge Power Generating Plants at the Mines and Pooling of Power

A RADICALLY new power policy for the state of Pennsylvania is proposed in the report of the Giant Power Survey Board, whose report to the legislature was transmitted last week by Governor Pinchot. The major features of this new policy are (1) the generation of power at mine-mouth steam plants, (2) the extensive utilization of byproducts from the coal, (3) the pooling of all power in one or more so-called reservoirs of power and the drawing therefrom of the power as needed by the separate users, and (4) the separation of power business into three elements, production, transmission, and distribution, no two of which may be controlled by the same interests. The report does not advocate state ownership but extensive state regulation.

The Giant Power Survey Board was appointed by the Pennsylvania Legislature in May, 1923, to study the power situation within the state, to report on the practicability of generating electricity at the coal mines, of co-ordinating all sources of power and of making cheap power available generally throughout the state and especially in the rural districts. The board consists of the governor as chairman, the attorney-general, the secretary of the water supply commission, the commissioner of forestry, the chairman of the public service commission, the secretary of agriculture, secretary of labor and industry, state geologist, and a deputy attorney-general and an engineer to be appointed by the governor. Morris L. Cooke is consulting engineer and director of the Giant Power Survey and Maj.-Gen. William Crozier is chairman of the advisory board.

The survey board, in its report, points out that the public power policy in Pennsylvania must be chiefly concerned with electric current produced by steam from the rich bituminous coal deposits in the western part of the state. Water power supplied only 11 per cent of the total consumption of the state in 1922 and even though it is entering a period of intensive development, it will never supply a greater per cent of the power requirements of the state than it does at present. In order further to foster the development of water power, the board recommends that legislation be enacted to make it legal for hydro-electric and steam-electric power companies to consolidate.

Turning to the generation of electricity by steam, the board enumerates the following five special essentials:

(1) Adequate public agencies obligated to a scrupulous regard for investors' rights as the surest means of attracting the constant stream of new capital necessary for rapid expansion; (2) mass production at the sources of raw material; (3) mass transportation to all parts of the commonwealth by an integrated system of transmission lines; (4) effective, simple and stimulating regulation from the coal mine to the power consumer, which means the passing on of the abundance and cheapness to him; and (5) fair and justly regulated interchange of power with other states, which means increased abundance and cheapness.

As the board finds that no one of these essentials now exists in fact or is adequately provided for by law, it recommends the creation of the following public agencies:

(a) A permanent Giant Power Board to carry on the study of the problem and to direct the application of natural resources to state-wide electric service, the board to have power to establish standards of equipment for the electrification of the steam roads in Pennsylvania; and (b) enlargement of the powers of the public service commission to enable it to control adequately the financial and commercial operations of electric facilities.

In order to secure the cheapness and abundance of mass production in the coal fields with the added economies of by-products recovery, the board recommends:

(a) Legislation authorizing the incorporation of giant power generating and giant power transmission companies empowered to do the following things, namely—the generating companies: To construct in the coal fields steam electric stations of not less than 300,000 kw. capacity (the minimum size limit indicated for profitable byproduct recovery); to mine coal; to sell the coal which is more suitable for byproduct recovery elsewhere than in the electric generating stations; to appropriate by condemnation process the right to mine coal on specific lands not to exceed an area reasonably estimated to be sufficient supply for not more than 50 years; to make and sell coke, gas and other byproducts; to sell at wholesale electric current to public service electric companies for distribution in Pennsylvania and for transmission to other states under contracts to be negotiated with the other states; and to purchase surplus current from other generating stations. The giant power transmission companies should be common carriers of current purchased and produced by the giant power generating companies. For this purpose, they should be empowered to operate transmission lines of not less than 110,000-volt capacities, so located as to secure the best interconnections with other common carrier transmission lines.

The Giant Power Board should be authorized to issue permits to the giant power generating stations and transmission lines, permits to be limited to a maximum period of 50 years, and conditioned upon the right of the commonwealth, or another permittee designated by the commonwealth, to take over and operate the works at the expiration of such period, upon the repayment to the permittee of the money prudently invested on the faith of the permit. For the right to occupy and use lands of the commonwealth, the permit should fix an annual charge with a view to amortizing the cost of the land strips within not more than 50 years.

To secure cheap mass transportation, the board recommends:

(a) That all other public service power business be segregated into three classes: (1) Major generation; (2) major transmission, and (3) distribution, also that no corporation be allowed to do more than one of these three kinds of business: (b) That the board be required to divide the state into transmission districts and that every major transmission system be constituted a common carrier for the transmission district in which it lies with the duty of taking electric current of standard voltage and frequency from all public service generating stations in the district and delivering it to all consignees which are public service distributing systems in the district; and (c) that two new classes of distribution systems be authorized by law—rural electric districts and mutual electric companies.

To secure effective regulation that will pass down to the consumer the cheapness and abundance of the power, the board recommends:

(a) That the powers of the public service commission be enlarged to include, as to electric power, the regulation and reformation of contracts for construction, lease and management; contracts for brokerage; contracts, facilities, service, and rate between common-carrier power companies; accounting; future security issues; and maintenance of facilities; (b) that the basis of rate regulation for giant power generating and transmission companies be the amount of money hereafter prudently invested therein; (c) that to all other public service generating, transmission and distributing companies, and to all other power companies hereafter exercising the right of condemnation, the basis of rate regulation shall be the amount of money prudently invested after Jan. 1, 1926, plus the value as of that date of all property then used and useful in their public service; (d) that no securities shall be issued by any giant power generating or transmission company or by any other public service power company without the prior approval of the public service commission; (e) that the rate imposed by the generating, transmission, and public service companies shall be so regulated that the rate of any company as a whole shall provide a sufficient reasonable return to attract into the enterprise new capital in sufficient volume to meet the needs of its public service duty, and if they do as a whole so provide, no part of them shall be deemed to be confiscatory; (f) that rates of distributing companies operating high-cost generating stations and desiring to substitute cheaper current delivered by a common-carrier transmission company may be fixed to provide for the amortization within a reasonable time of all or part of the generating equipment to be disused; (g) that the public service commission be empowered to authorize or reasonably require the extension of any distributing system to an unserved territory within the same transmission district; and (h) that the power of the court to review the proceedings, findings and orders of the public service commission be by statute reduced to the lowest terms consistent with the limitations of the state and federal constitutions.

To secure fair and justly regulated interchange of electric current with other states, the board recommends:

(a) That corporations generating, transmitting, or distributing electric current in Pennsylvania be prohibited from distributing current in another state at retail except to present customers in quantities fixed by existing contracts or to new customers in no greater quantities and at present points of delivery; (b) that a like prohibition be extended to deliveries in another state at wholesale over minor interstate lines (i.e. those of less than 50,000 volts or 25,000 kw. capacity); (c) that a like prohibition be extended to wholesale deliveries in another state over existing or future major interstate lines which shall not have been authorized by the Giant Power Board in pursuance of an interstate contract as recommended below; that the enlargement of existing minor interstate lines to the capacity of major lines without such authority be prohibited; and that the construction of new minor interstate lines be absolutely prohibited; (d) that existing contracts by any public service company for the delivery in another state of current transmitted or conveyed from Pennsylvania shall be subject to regulation and reformation by the public service commission to prevent discrimination in facilities, service or rates in favor of customers in other states and against customers in Pennsylvania; (e) that the Giant Power Board be authorized to negotiate with the representatives of other states contracts for ratification by the legislatures of the respective states and for approval by Congress for the regulation of interstate electric transmission on principles of mutuality, equality, justice and efficiency; also to grant permits for the construction of major interstate lines under such contracts.

The remaining part of the report is made up of a report of the director of the survey, going into the technical details of the electric power situation in Pennsylvania and the proposals of the board, to which are

appended six technical reports dealing with (1) Power Production and Utilization, (2) Industrial Power, (3) Natural Resources Available for Power, (4) Pretreatment of Bituminous Coals, (5) Rural Electrification, (6) A Giant Power System. Following these reports are proposals for legislation to put the recommendations of the board into effect.

Baltimore Zoning Ordinance Partly Upset by State Court

THAT part of the zoning ordinance of the city of Baltimore which prohibits the use for business purposes of property in residence districts has been declared invalid by a 5 to 2 decision of the Court of Appeals of Maryland, reversing a decision of the Superior Court of Baltimore City (Daniel Goldman vs. J. Frank Crowther, Inspector of Buildings for Baltimore, et al.; the decision in full is given in the Baltimore *Daily Record*, Feb. 7, 1925). The gist of the decision is that under the constitution of Maryland and the long line of decisions of its highest court, application of this part of the Baltimore zoning ordinance is in effect a taking of private property for public use without compensation not justified under the police power. The original petitioner in the suit was one Goldman who, in May, 1923 "undertook to use the basement of a four-story dwelling owned by him for repairing by hand and an ordinary sewing machine for hire, used clothing for such patrons as had occasion to require his services." No repairs or alterations to the building were required or intended. The parties to the suit agreed to a statement of the facts, eliminating all considerations except whether the right of the appellant to use his property as described "is a valid and enforceable enactment." Continuing the court declares "that there is nothing in the record from which it can be inferred that such use is offensive to the eye, the ear or the nose of a person of ordinary sensibilities or that it imperils the public health, welfare or safety, any more than would the same character of work done by Goldman for himself and his family except that possibly more of it is done."

Majority Opinion—That part of the syllabus that holds the use feature of the ordinance invalid and states why is as follows:

That so much of the ordinance as attempts to regulate and restrict the use of property in Baltimore City is void, first, because it deprives property owners of rights and privileges protected by the constitution of the state; second, because such deprivation is not justified by any consideration for the public welfare, security, health or morals apparent in the ordinance itself; and third, because it does not require that restrictions shall in fact be based upon such consideration; but this does not mean, that the use of property in Baltimore City may not be regulated or restricted where such regulation or restriction is based upon such consideration.

That those provisions of the ordinance which undertake to regulate the height of buildings and the areas of yards and open spaces adjacent thereto, as well as the number of families who may dwell therein, are not passed upon, because conditions of which the court is not informed by the record in this case may affect their validity.

That the contention that the ordinance improperly extends the jurisdiction of the Baltimore City Court cannot be sustained.

That the power granted to the Board of Zoning Appeals to disregard and set aside the provisions of the ordinance in particular cases fails to provide any proper standards or rules by which the discretion of the board must be guided and limited in so far as it applies to the "use" provisions of the ordinance.

That if the permit in this case was refused on no other ground than that the business which the appellant proposed to operate was in a residence district, then the permit should have been issued.

In the course of its lengthy opinion the majority of the court states that the questions at issue "can be approached by either of two avenues; one legal, the other political and sociological." From the former the city is held to have no case whatever, while from the latter, although the majority of the court does recognize that there are sociological factors that might be considered and cites cases in other states where these have been taken into account yet the majority holds that these cannot be given sufficient weight in the present case to sustain the validity of the ordinance.

From Minority Opinion—The dissenting opinion in reviewing some of the main facts and arguments in the case, with particular reference to municipal development and control of the uses of property in the public interest, has this to say particularly in regard to conditions in Baltimore and the justification of the ordinance:

We have only vague information of problems which have already arisen in still larger cities, and for which Baltimore should, therefore, be preparing. Can we confidently say from our own experience that there cannot have been any utilitarian or administrative ends which were thought by the promoters of the plan to demand the separation of business and dwellings as a larger method of handling the congested population with which the officials will have to deal in the future? May not the rapid changes in city traffic problems be met more easily by some such plan? And the increased difficulty of suppressing crime brought about by the use of automobiles for sudden arrival and flight, may there not be some aid for the meeting of police problems in the zoning plan? Or, more accurately, could not the officials of the city have thought so? And may it not be that the stresses and strains of living in a large modern city, with all its complex activities, have grown to a point where the separation of business from dwelling places offers a material, or even necessary, aid in the maintenance of the health and vigor of the city population? May it not be that in the growth of our predominantly industrial civilization we have arrived at a point where special protection is needed for the mere business of living? And is it not permissible to make some arrangement for a crowded city population which promises an improvement over the haphazard jumble which may now result from the uncontrolled wills and interests of neighboring owners? A city is a joint enterprise, and co-operation is almost the first law of its population if their joint living place is to be kept tolerable as the congestion of affairs in it increases. And if we regard property owners as holders of abstract rights, the same in the country as in a city, we may reverse the process to which they commit themselves as residents or beneficiaries of the city.

We take the view that the possibilities pointed out for improvement in living conditions and in the handling of administrative problems may well have justified the adoption of the separation of business and the dwelling places for the future, under the police power, and that this measure of co-operation required of the citizens is one which the judges cannot say is arbitrary or unnecessarily oppressive. And, proceeding from this conclusion, we think, further, that the vesting of so wide a discretion in the Board of Zoning Appeals by the provisions of the ordinance cannot properly be held an unconstitutional delegation of legislative power.

A new zoning ordinance drafted in the light of the decision is under consideration.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Some Criticisms of the Chicago Drainage Canal Engineering Report

Sir—I have read with great interest the report of "The Engineering Board of Review of the Sanitary District of Chicago," referred to in recent issues of *Engineering News-Record*. Remembering, (1), that Chicago was given temporary permission by the War Department some twenty years ago to divert 4167 sec.-ft. from Lake Michigan for the drainage canal so that it could meet in the emergency the unhealthy conditions which had been permitted to develop and have an opportunity to work out a final scheme; (2) that it has continued to use much more than this in defiance of law; (3), that it took the federal government ten years, due to delays instituted by Chicago, to secure an injunction; (4), that during all this time Chicago continued to develop this system so that it cannot now be changed without huge loss and costs, and (5), that the Supreme Court has recently upheld the injunction, it would appear that Chicago has at last been brought to the point where she has to really face her problem. She therefore is attempting to secure public support for her demands for "10,000 sec.-ft. and sometimes more" so that she may get the necessary federal authorization. This report is simply one step toward advancing her case and securing the needed support.

If the report was put forward simply as a masterly statement, by acknowledged experts, of Chicago's interests no one could take exception to it. On the other hand it is obviously not intended that it be taken this way. The board is composed of twenty-eight distinguished engineers whose biographies follow the report. It is evidently expected that this will stamp the work as a sort of engineering referendum. Furthermore these engineers preface their report with the statement, "The board counsels fairmindedness and avoidance of exaggeration, that the whole truth be made widely known, and that the facts be dealt with in an unbiased way by all parties." This naturally leads the reader to believe that the report does this and that he is correct in accepting it as representing the consensus of engineering opinion as to what is best, right and fair in the interests of all parties concerned.

Of course this is not the case. The engineers have very clearly subordinated other interests to those of their client. Several important results of the Chicago diversion have been only mentioned briefly or are minimized. The statements in some cases even seem to be misleading. Among these is the power loss which this diversion occasions consumers in New York State and the consequent waste of coal.

In 1910 the existing treaty with Great Britain was made which is generally considered unfair in its division of water rights at Niagara, Canada being allotted 36,000 cu.ft. per sec. and the United States 20,000, although there is 50 per cent more of the Great Lakes drainage in the United States than in Canada. No records are available to show exactly how these figures were arrived at. It has been suggested that the division was unequal because the great bulk of the water, 94 per cent, passes over the Canadian Falls and more water could therefore be taken on the Canadian than on the United States side without interfering with the scenic beauty. On the other hand it is fairly well recognized that Secretary Root agreed to this division because he knew that Chicago was taking out something near 10,000 cu.ft. per sec. down the Chicago River. At the same time he was not willing to have this go on record in the treaty because Chicago had not received legal rights to this quantity and he further did not want to have Lake Michigan on record as a boundary water. The statement in the Chicago report that "the water diverted at Chicago does not now and will not prevent the development of all the power which it is possible to develop at Niagara by diversions now *allowed by treaty*" (italics ours) is therefore absolutely true. It is misleading, however, in that it implies that the diversion by Chicago had no effect on the treaty division at Niagara while there can be little doubt that it actually caused a loss in water rights to the people of New York State. In any readjustment of the treaty provisions, which readjustment is certain to come, this diversion is certain to be charged up to the United States.

The board further states "The water diverted from Lake Michigan reduces the flow of the Niagara and St. Lawrence Rivers about 5 per cent and thereby the power that may ultimately be developed on these rivers; but at present, under treaty restrictions, only about one-quarter of the flow of the river is available for power and not quite two-thirds of the power possible from such permissible water is at present produced." As a matter of fact every drop of water allowed the United States is used at present for power at Niagara but the plans, which have been filed for some time, for utilizing the head in the lower gorge and rapids have been held up by Governor Smith's attempts to introduce state ownership and operation in New York. As a matter of fact the 5 per cent of the total flow taken by Chicago is 20 per cent of the present net flow (about one-quarter of the total) and if this is charged off to the United States, even on the basis of an equal division with Canada, this innocent 5 per cent becomes 40 per cent of the flow available in the United States. The above statement, therefore, seems to be distinctly misleading.

Again we quote "there will be no economic loss of power either on the Niagara or St. Lawrence River by reason of the diversion of water from Lake Michigan until 95 per cent of the available power at each location has been developed." We cannot see how this can possibly be true. Any use of the flow at Niagara must consider preserving the scenic effect of the falls. A dry Niagara is only very remotely possible; a certain percentage of the flow which would naturally go over the Falls is all that we can expect to divert. The water diverted by Chicago would, under natural conditions, go over the Falls, and hence must be deducted from the net available flow and the net available power. The above statement, therefore, refers to a condition which cannot reasonably be expected to exist, is certainly misleading and not a fairminded statement of facts.

It is with these facts in mind that the writer ventures to criticize the report on the ground that it is not a fairminded and unbiased statement of the problem in the interests of all parties concerned, whereas it appears to have been issued with the intention that it should be accepted as such. It seems that some diversion at Chicago is essential. This diversion should be reduced to a minimum and Chicago should not only participate in meeting the cost of regulating works needed to make good the effects of this diversion for navigation but should also compensate New York State for this infringement on her riparian rights.

New York City,
Feb. 17, 1924.

J. K. FINCH,
Associate Professor of Civil Engineering, Columbia University.

Underpinning Method Not New

Sir—I note in *Engineering News-Record*, Jan. 22, 1925, p. 145, an article by George E. Goodall in which is described "a new and unique method of supporting concrete columns" for underpinning purposes. I wish in this connection to call attention to the fact that I used this method four years ago in supporting concrete columns of the Yawman & Erbe Manufacturing Plant at Rochester under which new foundations had to be installed.

This method was described in *Engineering News-Record* Dec. 9, 1920.

The details I used in the application of this method differed from the ones described by Mr. Goodall in two respects:

1—The jackets were cast around the old columns instead of gunited.

2—The steel beams under the jackets were suspended from the main needle beams by means of threaded rods which were used to pick up the load thereby doing away with the use of jacks.

R. L. BERTIN,
Chief Engineer,
White Construction Co., Inc.

New York,
Feb. 13, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Florence Lake Tunnel of Big Creek Project Completed

The 13-mile Florence Lake tunnel, a part of the Big Creek project of the Southern California Edison Co., is finished. The last of the three sections was holed through on Feb. 18, the second having been completed Feb. 11. The 2.3-mile central connection between the two end sections (6.6 and 4.0 miles long respectively, exclusive of adits) was completed Oct. 29, 1924. A progress report on the tunnel was published in *Engineering News-Record* Dec. 25, 1924, p. 1050.

This tunnel has been under construction since the fall of 1920. It runs under Kaiser ridge and with the exception of a few thousand feet in soft ground, its entire length is in hard gray granite. Ten per cent of the tunnel is lined with concrete. The grade is 17.2 ft. per mile and with a minimum section of 15 x 15 ft. the capacity is figured as 1,500 sec.-ft. It will take water from the upper San Joaquin River at Florence Lake, for the present, and later the waters of Mono and Bear Creeks will also be diverted through this tunnel to Huntington Lake, the reservoir that supplies water for the chain of plants on Big Creek owned by the Edison Co.

The most rapid progress made in driving the tunnel was the 692 ft. made in one month, which is claimed to be a world's record. Average daily progress for all headings figured on a yearly basis, was as follows:

Year	Advance per day per heading (ft.)
1921	5.6
1922	12.7
1923	13.0
1924	15.8
1925	16.0

The tunnel was originally scheduled for completion in time to catch the spring runoff of 1927 and is finished 22 months ahead of schedule. The total cost of the tunnel, including roads, interest, overhead, etc., is stated to be $17,000,000 or $230 per linear foot.

Power Company Announces Construction Program

The Pacific Gas and Electric Co. of San Francisco, Calif., has announced a construction program for 1925 involving the expenditure of $17,821,000. Among the items of new work included in this budget is $2,500,000 for work on the hydro-electric project to be known as Pit River No. 4, the next plant in the series being built on Pit River and which will be located immediately below Pit River No. 3. The ultimate cost of this plant will be about $15,000,000. It will involve the construction of a diversion dam and a 4-mile tunnel that can be driven from only two headings and will produce about 135,000 hp.

Engineering Fifty Years Ago

From *Engineering News*, February, 1875

THE necessity of an abundant supply of pure water to the health and comfort of a community is generally admitted; but though Nature has been most bountiful in supplying us with the life-sustaining fluid, and though no other civilized people are more lavish in the use of it than ours, yet we may venture to assert that throughout the United States and the neighboring Dominion, there are several thousands of considerable towns and villages, and some cities, where the supply is very inadequate indeed, or where each family is obliged to obtain a sufficient quantity for use as best it may.

While the question is not yet of such vital importance to the people of this country as to those of the older and more thickly populated districts of Europe, it is still one that is daily growing in magnitude.

Has the engineering profession of this country given this subject the attention which it deserves? It is its province to do so. If they wait for the town authorities to move in the matter, most of the present generation will have gone to the place (let us hope) where the inhabitants thereof, "thirst no more," but if these same "selectmen," "trustees," "supervisors," or whatever they may be called, are brought face to face with a proper array of facts illustrative of the advantages of certain sanitary improvements, and the subject is freely agitated in the local press, their attention cannot fail to be secured and in many cases the improvements ordered. To facilitate this, we suggest to engineers that it will not cost a very large sum to take the necessary measurements and levels, and estimate the cost of giving to certain towns and villages an abundant supply of water and that during the present "dull times" they might make these preliminary surveys and estimates at their own expense.

Bills to Authorize Zoning Before Texas Legislature

To meet the situation created by adverse court decisions, Dallas and other cities of Texas are promoting legislative bills to authorize zoning. The bills have been so drawn as to give municipalities the right to adopt regulations designed to promote public health, safety, morals and welfare, leaving to the courts, says the attorney general in an approving opinion, to decide whether private rights are infringed by such procedure.

Weeks Begins Hearings on Chicago Lakes Diversion

Active Work on City's Part in Reduction Foreseen—5-Year Permit Deemed Probable

Washington Correspondence

Secretary of War Weeks last week entered upon hearings in the matter of diversion from Lake Michigan at Chicago, convinced that he has full authority to issue a temporary license prescribing the conditions under which this water may be used. It seemed apparent from Secretary Weeks' questions that the permit would be so arranged as to insure active work on the part of the Chicago authorities looking to the reduction of the amount of the diversion.

While the Secretary made it clear that he appreciates the political situation with which Chicago officials are confronted, he apparently thinks there are no insurmountable obstacles in the way of formulating definite plans looking to material reduction in the amount of lake water used at Chicago and to higher lake levels by compensating for a part of the water it always will be necessary to use. The principal thing, Secretary Weeks seems to think, is to establish proper objectives and work toward them consistently. He doubtless considers that early evidence of the city's good faith can be furnished by the metering of all water. He has been convinced that the per capita use of water in Chicago is excessive and that the cost of installing meters will practically be offset by the saving in pumping expense.

It is expected that a permit for five years will be granted. One of the conditions probably will be that sewage disposal for 1,200,000 persons be provided in that time. At the end of that period a better conception of the entire project will be possible. Such a condition, it is pointed out, would provide for the completion of less than one-fourth of the entire sewage-disposal project when the probable growth of the city over a twenty-year period is considered.

The development of power at Chicago and other matters came in for incidental mention only at the hearing.

Three-Cent Gas Tax Bill Passes Indiana Senate

In the face of considerable opposition the Cann bill in the Indiana Senate to increase the gasoline tax to 3c. a gallon has been passed by a vote of 29 to 17 and now goes to the House for action. As the bill appeared, when passed, it wou'd provide for all the money raised by 2c. of the tax to be turned over to the state highway commission and the extra cent to be turned back to counties.

Sanitary Oyster Control Aim of Conference

Resolutions for Standard of Federal, State and City Control Adopted —Committee Created

A resolution favoring a $75,000 appropriation to the United States Public Health Service for the sanitary inspection and control of oysters and a series of resolutions, given in full below, stating guiding principles for uniform federal, state and city control of the oyster industry from the health viewpoint were adopted in Washington, Feb. 19, by a conference called by the U. S. Public Health Service. A steering committee for future action was named by the conference. Over a hundred persons, from some twenty states, representing both health and fisheries officials and the shellfish industry were present.

There was some sharp questioning during the conference as to its having been proved that oysters were the cause of the recent excess of typhoid fever in New York City and elsewhere, and as to the justice of dealing so staggering a blow to the oyster industry on such scanty evidence of specific pollution. The final consensus of opinion favored concentration on the problem of future sanitary control of oyster production and marketing.

William Downs, of New York, secretary of the Middle Atlantic Fisheries Association, urged that the effect of sewage disposal on oyster fields be studied and that advice be sought from sanitary engineers outside as well as within the Public Health Service.

After the conference, Hugh S. Cummins, Surgeon General Public Health Service, was reported as having said that there is no more reason to fear oysters than other food at present, and that oysters are safer now than for several years past.

Conference Resolutions

The conference resolutions as to principles which should guide oyster control in the future, credited to Dr. W. A. Evans, formerly health commissioner of Chicago and for some time past health editor of the Chicago *Tribune*, follow:

"1. The beds on which shellfish are grown must be determined, inspected and controlled by some state and federal official agency.

"2. The plants in which shellfish are shucked or otherwise prepared or packed by the shipper must be inspected and controlled by some state and federal official agency.

"3. The freedom from typhoid bacilli of the workers who handle shellfish must be determined by some official governmental agency.

"4. Failing to secure sufficiently high standards to protect the people as regards beds, floating and pumping practice and methods of shucking or other methods of preparation, a satisfactory practical method of pasteurization or other heat treatment, or chemical or biological method which produces satisfactory results must be installed and operated under proper governmental supervision.

"5. There must be such governmental supervision and such trade organization as will make plain the source of shellfish and will prevent shellfish from one source being substituted for those from another source. This will be chiefly a problem of the individual state.

"6. The methods of shipping must be supervised, inspected, controlled and approved by the proper official federal and interstate agency.

"7. The methods of storing, displaying for sale and dispensing must be determined, inspected and controlled by the proper state or city agency.

"8. The product must conform to an established bacterial standard and must meet federal, state and local laws and regulations relative to salinity, water content, food proportion and conform to the pure food law standards. There should be a revision of the existing bacteriological standards for oysters."

The joint program or steering committee, is made up as follows: *Federal*, Surgeon W. H. Frost of the Public Health Service and Dr. Lewis Radcliffe of the Bureau of Fisheries; *State*, Dr. H. B. Costill of New Jersey, Dr. John M. Fulton of Maryland, Dr. Oscar Dowling of Louisiana and Dr. A. T. McCormick of Kentucky; *Shellfish Industry*, W. H. Killiam of Maryland and J. S. Fowler of New Jersey for the Shellfish Dealers' and Growers' Association of North America.

Court Decision on Riparian Right to Flood Waters

After a hearing extending over six weeks before the Superior Court of California sitting at Fresno, Calif., the Herminghaus estate including 18,000 acres of land on the lower San Joaquin River was granted an injunction by that court on Feb. 13 which estops the Southern California Edison Co. from constructing more storage reservoirs on the San Joaquin River.

The plaintiff owns lands on which are used waters taken from underground storage replenished by flood waters of the San Joaquin River. Storage and regulation of the stream flow, the plaintiff claims, will curtail this source of water supply. Judge J. E. Wooley, who wrote the decision, held that the case hinged on what may be considered a reasonable exercise of riparian rights. "I can see no difference in principle, he said, "between an actual diversion from the river of water not to be used on riparian lands and the impounding of the water over long periods by an upper riparian owner. The injury consists in either case in preventing the water from flowing in its natural way. It seems to me that no argument can be advanced based on authorities, particularly in the West, that would justify the impounding and storing of the water as the defendant in this case contemplates doing. Such a use would be an unreasonable use." Appeal of the case to the Supreme Court of California is expected. Meantime construction work under way on the Big Creek project will not be affected because further storage reservoirs are not essential to the work now in progress.

Constitutional Zoning Amendment Proposed in New Jersey

In accordance with a recommendation of Governor Silzer in a special message, a resolution providing for a constitutional amendment authorizing municipalities to pass zoning ordinances has been introduced in the New Jersey Legislature. This action has been caused by decisions of the highest court of the state against the use of zoning regulations under which permits for business in residence districts had been denied.

Mulholland Highway Opened with Celebration

A new boulevard named the Mulholland Highway in honor of the Los Angeles aqueduct builder has been completed in the city of Los Angeles extending a distance of 25 mi. along the crest of the hills from Cahuenga Pass to Calabasas. The new roadway, which is within the city limits for its entire length, was formally opened to traffic by the Board of Public Works recently. The event was made the occasion of a celebration at Calabasas to which many thousands of automobiles proceeded via the Ventura Boulevard. After a barbecue, rodeo and dedication speeches a chain of roses was broken and the automobile parade returned to Los Angeles over the newly-completed highway.

Assistant Secretary of Interior on Reclamation Review Board

Francis M. Goodwin, Assistant Secretary of the Interior, has been appointed by Secretary Work as a member of the board now being organized to review and reappraise federal reclamation projects. This board is headed by Ex-Governor Thomas E. Campbell of Arizona, and Dr. John A. Widtsoe of Utah. Selection of Mr. Goodwin for the board by Secretary Work was due to his wide experience and extensive knowledge of irrigation problems and his thorough familiarity with the Northwest.

Mr. Goodwin has been Assistant Secretary of the Interior during the past four years. He has had supervision over reclamation projects located on all the Indian reservations throughout the West, handling the letting of contracts for construction work, as well as personally inspecting virtually all of them. He has also made surveys of many other projects under the control of the Reclamation Bureau.

During this time, Mr. Goodwin acted as chairman of the commission investigating the proposed Columbia Basin project in the state of Washington. He will continue as head of this commission until its work is finished and its conclusions are finally sent to Congress.

The board of review and appraisal of federal reclamation projects, of which Mr. Goodwin has been made a member, will begin its work at once visiting practically all the projects in the West, examining into questions connecting with their reappraisal before making a final report to Congress at its next term.

Engineering Foundation Plans Huge Endowment

Electrical Engineers' President Makes Proposal for $20,000,000 Research Fund

Election of Lewis Buckley Stillwell as chairman of the Engineering Foundation, through which research is carried on by the organized engineering profession of the United States, has been announced following the tenth annual meeting of the Foundation board at the Engineering Societies Building, 29 West 39th Street. Announcement was also made that the four founder societies of civil, mining, mechanical, and electrical engineers had begun the study of plans to increase the endowment of the Foundation, established by Ambrose Swasey with a gift of $500,000, and recently supplemented by a bequest of $50,000 under the will of Henry R. Towne. Farley Osgood, president of the American Institute of Electrical Engineers, has, it was stated, brought forward a proposal that the endowment be raised to $20,000,000.

Other Officers

Mr. Stillwell, nationally known as an engineer, succeeds Charles F. Rand, who declined re-election after serving five years. Edward Dean Adams was elected first vice-chairman. He has served as first vice-chairman since May, 1915. Elmer A. Sperry, gyroscope inventor, was chosen second vice-chairman. Other officers named are: treasurer, J. S. Langthorn; assistant treasurer, Henry A. Lardner; director and secretary, Alfred D. Flinn. To the board the following were elected as trustees of the United Engineering Society: George H. Pegram, American Society of Civil Engineers; J. Vipond Davies, American Institute of Mining and Metallurgical Engineers; W. F. M. Goss, American Society of Mechanical Engineers; Bancroft Gherardi, American Institute of Electrical Engineers.

These eight members nominated by the governing bodies of the Founder Societies were chosen: Edward Dean Adams, Robert Ridgway, Arthur L. Walker, H. M. Boylston, Arthur M. Greene, Jr., George A. Orrok, Gano Dunn, L. B. Stillwell. Elmer A. Sperry, Charles F. Rand, and Arthur D. Little were named members at large. W. L. Saunders, chairman of the Naval Consulting Board, will be a member *ex-officio* as president of the United Engineering Society.

Mr. Stillwell, a New York engineer residing in Lakewood, N. J., is past-president of the American Institute of Electrical Engineers, and the American Institute of Consulting Engineers. He is a native of Pennsylvania and a graduate of Lehigh.

Kansas City Adopts City Manager Plan by 4 to 1 Vote

The proposed new council-manager charter for Kansas City, Mo., outlined in our issue of Feb. 12, p. 294, was adopted on Feb. 24 by a popular vote of about 4 to 1. The charter will go into effect on April 10, 1926.

Survey to Aid in Deciding Next Step in Skagit Progress

In an endeavor to determine what shall be the next step in the development of the Skagit project the city council of Seattle has passed an ordinance creating a commission to make a complete survey of the proposed additions and appropriating $12,000 to defray expenses. All basic data on the project assembled by municipal officials will be turned over to the commission. Its investigation, which is to be begun immediately, is not expected to require more than three months, and upon its report will depend largely the decision as to whether erection of the Gorge dam or the Ruby dam will be the next step undertaken.

Engineers named by the council to compose the commission are William C. Morse, consulting hydraulic and hydro-electric engineer; Stirling B. Hill, of the firm of Parker & Hill, consulting civil and hydraulic engineers; and Joseph Jacobs, of the firm of Jacobs & Ober, hydraulic engineers.

The ordinance further provides for a study of the municipal distribution system by a second commission of engineers, with a view to determining its needs. This commission has not yet been appointed. The ordinance was passed over the veto of the mayor.

Chicago to Advance Funds for Track Elevation

An important piece of track elevation in Chicago is that of the Chicago, Milwaukee & St. Paul Ry. in the Mayfair district, where the line crosses the Chicago & Northwestern Ry., which latter road has been elevated recently. Owing to the inability of the railway company to finance this work, the city has included an item of $1,500,000 in the bond issue to be submitted to vote on Feb. 24. The company is to repay the city in twenty annual installments, with interest.

Traffic Relief Planned for Downtown Boston Streets

Nearly 10,000 Ft. of New and Widened Streets To Cost $25,000,000 Recommended to State

The Special Recess Commission on Intermediate Thoroughfares in Boston has submitted to the Massachusetts Legislature a plan for two extensive and several lesser street widening and opening improvements at a gross cost of $25,600,000, or $24,250,000 deducting a land reclamation credit at one point. The cost would be met, in the first instance, by short-term bonds, but ultimately from taxes, to begin in 1926, levied upon both automobiles and real estate.

City automobile taxes would go into a highway improvement fund; in addition, all real estate in the city would pay a special tax of 50c. per $1,000 and all real estate in a central district an additional tax at the same rate into the fund. Construction work, which as the accompanying table shows, is estimated at only $1,350,000, would be done by the Boston Department of Public Works, but the program otherwise would be in charge of a commission of five of whom three would be the regular street commissioners of Boston.

The members of the commission are: Henry I. Harriman, chairman, who is also chairman of the Metropolitan Planning Division; Frederic H. Fay, chairman of the City Planning Board; Judge Michael H. Sullivan, chairman of the Boston Finance Commission; Colonel Thomas F. Sullivan, chairman of the Boston Transit Department; and John H. L. Noyes, chairman of the Board of Street Commissioners of the city of Boston.

Details of the plan, as summarized, in the Boston *Transcript* of Feb. 13, in its lengthy abstract of the commission's report, are given in the accompanying table.

SUMMARY OF STREET IMPROVEMENTS RECOMMENDED FOR BOSTON, MASS., BY RECESS COMMISSION

Street	Location	Length Ft.	Width Ft.	Estimated Cost: Land and Buildings	Estimated Cost: Construction	Estimated Cost: Total
1.	A new street—Charles River Dam to Causeway and Stantiford Sts.	1,500	100	$1,250,000	$135,000	$1,385,000
	Merrimac St.—Causeway St. to Haymarket Sq.	1,600	85	1,995,000	130,000	2,125,000
	Cross St. and extension—Haymarket Sq. to State St.	2,200	85	5,130,000	75,000	5,305,000
2.	Brattle St.—northerly side	500	80	1,950,000	40,000	1,990,000
3.	Dock Sq., Faneuil Hall Sq. and Union St.			3,920,000	80,000	4,000,000
4.	Exchange St.—southerly side	350	54	1,900,000	20,000	1,920,000
5.	Albany St.—Kneeland St. to Broadway	1,400	100	1,120,000	410,000	1,530,000
6.	A new street—Kneeland St. to Federal St.	2,000	85	7,185,000	160,000	7,345,000
	Total	9,550		$24,450,000	$1,150,000	$25,600,000
	Credit—Land reclaimed at Dock Square					1,350,000
	Net cost					$24,250,000

1. Construction of that section of the intermediate thoroughfare, devised by the Boston City Planning Board, which runs from the Charles River dam along the general line of Lowell St. to Haymarket Square and thence on the edge of the market district along the general line of Cross St. to the foot of State St. near Atlantic Ave.

2. In order to take care of the large new volume of traffic which will flow into Scollay Square when the Cambridge and Court St. widenings are completed, provide for the widening of Brattle St. "so as to give a suitable outlet from Court St. to the market and financial districts."

3. Clear up Dock Square completely, so that Faneuil Hall will stand at the foot of an unobstructed open thoroughfare.

4. Widen Exchange St. to a width of 54 ft. In these matters the commission says: "We have taken into consideration the probable re-routing of traffic. It seems to us inevitable that Tremont St. and Washington St. will comprise one pair of one-way streets. We feel also that a second pair of one-way streets will be made up of Federal St. and Exchange St."

5. Widen Albany St. from Broadway to Kneeland St.

6. Construct a new street from the corner of Albany and Kneeland Streets to Church Green and thence to Federal St. at the corner of Franklin St. This, in effect, is another, but modified section of the City Planning Board's intermediate thoroughfare.

Senate Returns Underwood Bill on Muscle Shoals to Conference

The Muscle Shoals bill was put in serious jeopardy February 23, when it was sent back to conference by formal action in the Senate. It is understood that the conferees are unwilling to agree to the Underwood bill in the exact form in which it passed the Senate. Any effort that they may make to perfect the measure carries with it the possibility of another point of order against it. In such an event the time is thought to be too short to permit of the passage of the bill before the end of the session on March 4. As this is written, it is said to be the intention of the conferees to alter the bill and report it promptly to the Senate.

When the conference report on the Muscle Shoals bill came before the Senate Senator Norris immediately made a point of order against it on the ground that the conferees had inserted new matter and were attempting to legislate by means of a conference report, procedure prohibited by the rules of the Senate. The presiding officer sustained the point of order made by the Nebraska Senator. Senator Underwood appealed from the decision of the chair. This resulted in protracted debate as to the parliamentary situation involved, but finally the chair was sustained in a close vote of 45 to 41. In response to a question by Senator Underwood the presiding officer held that the bill must be referred to the same conferees as had previously reported on it.

Boyd Resigns Presidency of Philadelphia Building Congress

A testimonial dinner was held in Philadelphia recently to D. Knickerbacker Boyd, retiring president of the Philadelphia Building Congress. The dinner was held at the Manufacturers Club and the attendance, which included members of the congress and friends, numbered 94. Letters and telegrams expressing the regrets of the senders, good wishes to the congress and felicitations to its president which were read included those from James J. Davis, Secretary of Labor; Dr. John M. Gries, chief, Division of Building and Housing of the Department of Commerce; Gen. R. C. Marshall, secretary of the A. G. C.; E. J. Mehren, vice-president, McGraw-Hill Co.; John Molitor, city architect, Philadelphia; F. W. Walker, secretary, Associated Tile Manufacturers; the *American Architect*, New York City; Richard L. Humphrey, consulting engineer, Philadelphia, Sullivan W. Jones, New York State architect, and Dwight L. Hoopingarner, New York Building Congress.

Speakers at the dinner beside Mr. Boyd included D. Everett Waid, president, American Institute of Architects; William Stanley Parker, president, Boston Building Congress; Thomas F. Armstrong, member and former vice-president, National Terra Cotta Society; Julian F. Millard, state supervising architect of Pennsylvania; Morris L. Cooke, consulting engineer, Philadelphia; and James S. Meade, secretary, Brotherhood of Electricians.

Engineers Oppose Law to Abolish Position of State Engineer

At a meeting of the New York Section of the American Society of Civil Engineers, held on Feb. 19, 1925, the following resolution relative to legislation pending in the New York Legislature for the reorganization of various departments of the state government was unanimously adopted:

Resolved, that the New York Section of the American Society of Civil Engineers register its disapproval of Senate Bill No. 23 (introduced Jan. 7, 1925 by Mr. Gibbs) in its present form, or of any constitutional amendment or statute which shall not make provision that the incumbent of that office having the powers and duties of administration, design, supervision and control of engineering works shall be a professional engineer of not less than fifteen years' experience and training in engineering work, and be it further:

Resolved, that a copy of these resolutions be sent all members of the New York State Legislature representing districts within the jurisdiction of the New York Section.

Plan to Dredge Stockton Channel to 26 Ft. Approved

Recommendation has been made by Maj. Gen. Harry Taylor, chief of engineers, U. S. Army, that the government assist in dredging the San Joaquin River channel from the city of Stockton, Calif., to deep water in Suisun Bay, which is connected by Carquinez Straits with an arm of San Francisco Bay. The report recommends that the channel be made 26 ft. deep at mean low water and 100 ft. wide at the bottom; that it follow the river route, with levees set back 230 ft. from the channel center; that suitable passing places and turning basins be provided; and that Mormon Slough be dredged from its mouth to Center St. to a depth of 9 ft. at mean low water and a width of 100 ft.

The recommendation is not expected to come up for consideration until the next session of Congress. In the meantime plans are being made by officials of Stockton for a bond issue to defray the city's portion of the cost, which has been estimated at $2,300,000. Maj. Gen. Taylor recommended a total expenditure of $3,715,000 for the proposed improvement. Of this the federal government would furnish $2,407,500, with $195,000 to cover maintenance the first year. After the first year the annual maintenance is estimated to be $125,000. Under this plan Stockton would be expected to provide $1,307,500 toward the first cost of dredging; to furnish suitable rights-of-way 750 ft. wide for the deep channel and the necessary width for Mormon Slough; to maintain levees annually; to furnish terminals and berths of 1,200 ft. for the first year and ultimate terminal development capable of handling 1,000,000 tons annually; to purchase land at once for terminal development; and to provide area to dispose of the dredged materials.

Random Lines

Enlarging the Draftsman's Opportunities

"Henry Ford is planning a widespread revival of the minuet, the schottische, the polka and other old time American and European dances of the 'good old days,' together with accompanying blueprints for the guidance of the feet," says a Detroit newspaper.

"Enlarged blueprints showing the series of steps and movements constituting the old time dances, together with musical accompaniments are in the course of completion by expert draftsmen at the Dearborn laboratories of the Ford interests," the dispatch continues. "A staff of investigators and draftsmen have been engaged in the work for several months."

Together with the clipping C. J. M. sends the query "dance engineers?"

* * *

Resting on His Labors

The genial gentleman resting so naively upon his transit is not the hero of a Western 7-reel thriller. He may be, however, equally as fictitious a character, for there is no clue to his

identity in the article on "Recollections of a Golf Architect" which he illustrates in *Golf Illustrated*. No wonder fairways are so hard to find.

* * *

Only a Scrub Woman

(An ad in a Camden paper)

WOMAN—Lavatory technician, preferably resident of Camden or vicinity. Apply Cooper Hospital.

* * *

Vital Statistics!

The following paragraphs are taken from a recent issue of "Railroad Data":

"The average distance traveled by passengers increased from approximately 38½ miles to almost 39 miles. The number of passengers in each car, however, decreased from 16.30 to 15.38, a decrease of almost one passenger per car.

"The average distance traveled by commuters increased from 14.37 miles to 14.64 miles. This shows the growth of suburban communities."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The Engineers Club of Northern Minnesota announces that its annual banquet will be held at Eveleth, Minn., on Feb. 28, 1925, also that the following officers have been elected for 1925: President, J. C. Hartness, Eveleth; vice-president, C. J. Calvin, Hibbing; secretary-treasurer, H. R. McAdams, Eveleth.

The Illinois Section of the American Water Works Association will hold its annual meeting at Evanston, Ill., March 17 and 18. Arrangements are being made to have other sections of the Association in the Middle West join with the Illinois section in this meeting.

The Canadian Section of the American Water Power Works Association will hold its annual meeting March 4 to 6 at the Windsor Hotel, Montreal.

Personal Notes

H. C. ACRES, formerly chief hydraulic engineer of the Ontario Hydro-Electric Power Commission, has been elected a member of the board of governors of the University of Toronto. He is a past vice-president of the Engineering Institute of Canada and a member of the Institution of Civil Engineers of Great Britain, also a member of the American Society of Civil Engineers.

ELWYN E. SEELYE, structural engineer, 101 Park Ave., New York City, announces the establishment of a special department for the control and design of concrete mixes along the lines of Lewis Institute methods. Directly in charge of this work will be George Conahey, whose service under Professor Abrams of Lewis Institute and with the American Portland Cement Association renders him particularly capable of taking charge of this work.

F. M. SHARP, North Vancouver, has been appointed engineer of the city of Nanaimo, Vancouver Island; for many years he was engineer of North Vancouver district.

CHARLES A. BROWN, assistant city engineer of Indianapolis, in charge of sewers and a member of the city engineering department for twenty-seven years, has resigned, effective March 1. Mr. Brown is among the best known engineers in his line of work in the Middle West. He is resigning, it is stated, because of health and the inadequate salary paid by the city. He will open independent offices.

I. C. MACKIE has been appointed examining engineer in charge of tests for the British Empire Steel Corporation.

JACOB FELD announces the establishment of offices at 103 Park Ave., New York City, for the practice of structural engineering, especially foundations and reinforced concrete. Dr. Feld leaves the employ of the Barney-Ahlers Construction Co. as designing engineer on March 1. He was formerly with H. D. Robinson and D. B. Steinman, consulting engineers, in the capacity of designing engineer on foundations and long span bridges.

THOMAS C. HAVELL has been nominated by President Coolidge to be assistant engineer of the General Land Office of the Department of the Interior, and the nomination has been sent to the United States Senate for confirmation. Mr. Havell at present holds the post of chief of the Division of Surveys and Drafting in the General Land Office; his service in this division began in 1899 and promotions brought him into the position of acting assistant chief in 1922 and assistant chief in 1924. Not long after entering the division, Mr. Havell for a time studied civil engineering in Columbia University; later he entered the National University Law School, graduating in 1923, obtaining through his experience and his education a comprehensive knowledge of public land engineering and law.

Obituary

Maj.-Gen. JAMES H. WILSON, Civil War corps commander and at one time chief engineer of the New York Elevated Ry., died suddenly Feb. 22 at his home in Wilmington, Del., aged 87 years. General Wilson, a native of Illinois, graduated from West Point in 1860 and was assigned to the topographical engineers. In 1863 as an aide to General McClellan, he served in the Antietam campaign; he then became a captain of engineers and was made a brigadier general the same year. His service was notable throughout the Civil War both in tactics and in engineering works. Following the Civil War he was for a short time engaged in the improvement of the Mississippi River; other engineering enterprises were connected with the permanent fortifications at Alexandria and Cairo, Egypt, and the development of railroads in the United States. In the 70's and 80's he was associated with George M. Pullman and Henry M. Alexander as a promoter of the New York Elevated Ry., of which for a short time he was general manager and chief engineer. His last important railroad position was the presidency of the New York & New England R.R. which terminated in 1883 with the merger of this road with the New York & New Haven R.R.

WILLIAM P. JUDSON, consulting engineer, Broadalbin, N. Y., and at one time deputy state engineer of New York, died Feb. 12 at his home in Broadalbin, aged 75 years. After graduating from the public schools of Oswego, N. Y., Mr. Judson became a draftsman and leveler in the work of rebuilding Fort Ontario by the U. S. Engineer Department and from that time until 1899 he was connected with United States engineering work in the state of New York, surveying and mapping Oswego harbor and the river and the city and its railroads. In 1892 and 1896 he made special reports on the canal question dealing with the route from Oswego to Troy through the Oswego-Oneida-Mohawk valley. Mr. Judson served as deputy state engineer from 1899 to 1905, and in later years was president of the Broadalbin Electric Light & Power Co.

JOHN B. BIRD, for the past thirty years chief engineer of the Joseph Bancroft & Sons Co., Wilmington, Del., died Feb. 15 at a hotel in Atlantic City, where he had gone for his health, of nephritis. Mr. Bird was born in Freeport, Pa., but most of the 54 years of his life had been spent in Wilmington. He had in his early years studied civil engineering and worked for a time on the engineering force of the Richmond & Danville R.R. and the Baltimore & Ohio R.R.

HEDLEY V. THOMPSON, consulting engineer, Toronto, Ont., died Feb. 15 at his home in that city after only a few hours' illness. He was a graduate of Mount Allison University and McGill University. Mr. Thompson had spent a number of years in the United States, with the American Bridge Co. at its plants at Trenton, N. J., and Pencoyd, Pa., but for the past fifteen years had practiced in Toronto.

LESLIE BRINKMAN, consulting engineer, St. Thomas, Ont., died Jan. 13 at New Orleans, La., aged 30 years. He was a graduate of Queens University, Kingston, Ont., and after serving overseas during the World War became assistant city engineer of Sarnia, Ont.; later he was resident engineer of the Ottawa-Pembroke section of the Provincial Highway. He resigned his position a year ago on account of illness and had gone South to recover his health.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Better Relations Between Manufacturer and Distributor

Prompt Deliveries Vital—Repair Lists Need Improvement—Personal Contact Helps

By B. E. Yancey
Yancey Bros., Equipment Distributors, Atlanta, Ga.

Part of an address before the annual meeting in Milwaukee, Jan. 3, of the Associated Equipment Distributors.

PRACTICALLY speaking, the distributor's relationship with his manufacturers is an individual proposition, but there are certain problems common to all of us, and it is to these that I want to direct your attention. Next to the all-important matter of sales, the most important, and certainly the most necessary, factor in better relationship between the manufacturer and distributor is deliveries.

Deliveries

With the resumption of better business and heavier production during the past year we have noticed a great tendency on the part of the manufacturer to fail to deliver goods on the dates specified. In a business such as ours, where the time element is so imperative and where delays mean costly waste of money for the contractor, deliveries are vital. Nothing gives the distributor a black eye in his territory so quickly as to fall down on delivery. If the manufacturer can't make delivery on the date asked for, don't promise it. It is better to lose the sale than to lose both the sale and the customer.

And don't rob Peter to pay Paul. I mean by that, if a manufacturer has a machine on his platform ready to ship to distributor A by a certain date, and distributor B wires he has to have a similar machine at once or lose a sale, let him lose it. That machine belongs to the first distributor. Last year we kept a contractor waiting 15 days, at a cost of several hundred dollars a day, just because the machine that should have been shipped to us was directed to another distributor.

Better Repair Lists—My company represents ten or fifteen manufacturers, and to be perfectly frank with you, there are some of their repair lists that I do not understand, and I don't believe even the men that compiled them understand. Every manufacturer should have a repair parts list covering his entire line, alphabetically and numerically arranged, and no two parts on different machines should carry the same number. I have given this matter considerable thought and this is my judgment on it. I think too that the manufacturer should abide by the distributor's advice in making settlement for small parts claimed defective, as he is on the job and is in a better position to handle the matter satisfactorily.

Mail Relations—Contact by mail is, at best, an unsatisfactory method, but it is made a great many times more so by the policy of some of our manufacturers. If you want to get good and peeved, try this recipe: Write an important letter to a manufacturer about a sale that is red hot, and then, in about 6 days, get back a letter from the third assistant to the third assistant vice-president, who doesn't know a thing on earth about it. Put your distributor's correspondence in the hands of a big man—a man who knows his business. There is nothing more important. It means money in your pocket.

Selling Methods

Now we come to selling, and its manifold ramifications. Let me give you an idea of the magnitude of this problem by citing our own case. We travel upwards of 20 men, and in addition to that we have a sales promotion department of three people that costs us more than $20,000 a year. That is practically 1 per cent of our sales.

What significance has that? Simply this: Every manufacturer we represent is paying his pro-rata part of that sales expense. Then isn't it up to the factory to help us get the most out of that department? Of course it is. We have any number of manufacturers who have never seen or talked to our men. Some of our manufacturers, in fact, have never been in our office. Our men carry catalogs of hundreds of pages. Your line is in that catalog. But don't you think it is worth-while to *know* whether our men are pushing your line or selling it right?

Two years ago, we took over a line of pavers and mixers. The first year we were fairly successful with it. Then last year the sales manager of the company came down, not once but twice. He wasn't an office sales manager; he was a territory sales manager. He went out with our men. Sold them his line. Taught them how to sell it. Then he sent down a man to be in the territory permanently. Did it pay? Well, in 1924 our sales of pavers and mixers more than doubled, and I will gamble that our 1925 volume will more than double that of 1924.

Don't get the idea that we, or any other distributor, want the manufacturer to sell his line for us. We don't, but we do want him to understand conditions we have to face, to give us the advantage of his advice and experience, and to go back to his factory with a better idea of Yancey Brothers than some of them have. I honestly believe some of our manufacturers think we are just a letterhead down in Atlanta, Ga., that sends in an order once in a while. We don't need sales sharks who come down and sit around the office all day and talk in figures of annual turnovers and sales resistance. We need practical men who can make their lines dominate our field.

I can't help telling you of something that happened last week just before I left home. One of our best lines sent us a shipment of folders entitled "Snow Removal in Winter," to be sent to our trade. Last year, the average snow fall in our territory was less than one inch. If that manufacturer had stopped to think, he could have saved himself that expense, or if he had had some one in his office who knew conditions in our territory, that could never have happened.

My message to the manufacturer, if he wants to promote better relations with his distributor, is this: Treat your distributor as an individual. Study his problems. Understand his territory and conditions. There is no set rule that will apply to all distributors. A thing that will sell a paver in Oakland, Calif., won't sell it in Atlanta, Ga.

Consider Census of Distribution in Industry

Washington Correspondence

While a wide demand already exists for a census of distribution to supplement the biennial Census of Manufactures, it is apparent that a higher head of public pressure must be created before Congress would consider seriously the large appropriation necessary. The cost is estimated at $1,000,000 but it is believed confidentially that such a census could be taken for less money.

Such a census of distribution is expected to receive the vigorous support of producers, as well as middlemen, and consumers, as accurate knowledge of the status of distribution would furnish additional light for the conduct of general business.

Building Uses 53 Per Cent Total Output of Lime

The lime sold in the United States in 1924 amounted to 4,022,000 short tons, valued at $38,670,000, according to estimates furnished by lime manufacturers to the Department of the Interior through the Geological Survey. These figures show a decrease of a little more than 1 per cent in quantity and 3 per cent in value from the sales in 1923. The sales of hydrated lime, which are included in these figures, amounted to 1,292,000 tons, valued at $12,972,000, an increase of about 5 per cent in quantity and 6 per cent in value. The average unit value of all lime showed a decrease from $9.81 a ton in 1923 to $9.61 in 1924, and that of hydrated lime an increase from $9.98 a ton in 1923 to approximately $10 in 1924.

About 53 per cent of the total output was used in building, 41 per cent in chemical industries, and 6 per cent in agriculture.

Business Notes

LINK BELT CO., Chicago, has recently erected a new two-story building at 5938 Linsdale Ave., Detroit, to which the branch office has moved from its former quarters on Woodward Ave. The new structure provides office space as well as a large warehouse in which a stock of chains for elevating, conveying and power transmission purposes, sprockets, clutches, malleable iron elevator buckets, etc., is kept for immediate shipment.

SCOTT VALVE MFG. CO., Detroit, Mich., manufacturer of bronze and iron body valves, has appointed Russell F. Kleinman, Land Title Building, Philadelphia, Pa., as sales representative in eastern Pennsylvania, southern New Jersey, Maryland, Delaware and the District of Columbia, and Charles H. Tinker Co., 201 Devonshire St., Boston, Mass., as New England representative.

CHARLES HAYDOCK, formerly engineer of the Pennsylvania R.R. Water Companies, has become vice-president and general manager of the Lansdale Foundry Co., Inc., Lansdale, Pa., manufacturer of grey iron and semi-steel castings.

FLORY MFG. CO., Bangor, Pa., has recently transferred Theodore Hanau from the New York sales office, where he had been for many years, to the home office at Bangor where he will direct the sales of contractors' marine deck and material handling equipment.

LYNN B. EASTON, manager of the Laidlaw Works of the Worthington Pump and Machinery Corporation, died Jan. 24, at the age of thirty-nine. He had been with the company, or its predecessor companies, for a period of twenty years, having started as a time clerk and worked up to the position he held at his death.

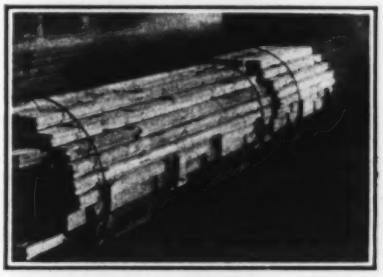
PARADON ENGINEERING CO., Long Island City, N. Y., manufacturer of chlorinating apparatus for water sterilization, announces that George E. Gilbert, formerly of the Wallace & Tiernan Co., Inc., Newark, N. J., has joined its organization. The Paradon company has recently appointed the following distributors: Water Works Supply Co., San Francisco and Los Angeles, Pacific Coast representatives; Charles T. McFarland, Mutual Building, Kansas City, Mo., Middle Western representative; Lawrence K. Cecil, 816 Colcord Building, Oklahoma City, Okla., Southwestern representative; and the General Supply Co. of Canada, Ltd., Ottawa, Montreal and Toronto, Canadian representatives.

Equipment and Materials

Heavy Creosoted Deck Supports Granite Block Bridge Pavement

Heavy creosoted decking of 6x10-in. tongued-and-grooved shortleaf yellow pine, cut in 17 ft. 2-in. and 19 ft. 7-in. lengths, was employed in repairing and strengthening the Harvard Bridge over the Charles River between Boston and Cambridge, Mass., recently reopened to traffic. The new floor structure carries a pavement of 3-in. granite block laid on a 1-in. course of asphalt mastic. The bridge is 2,100 ft. long, 70 ft. wide, and carries heavy traffic. The repair work involved replacement of the old wooden stringers with 12-in. I-beams on which 700,000 ft. b.m. of the new creosoted decking was laid.

The lumber was treated at the tie-treating plant of the Boston Elevated

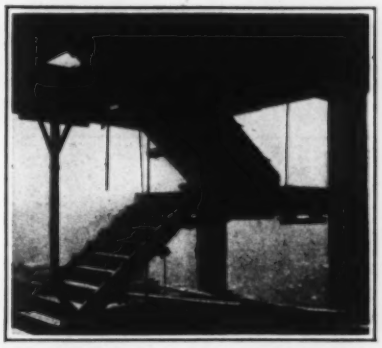


Ry. where a steaming of from 3 to 5 hr. preceded the application of creosote by the Rueping empty cell process, using a No. 1 grade A.R.E.A. creosote soil supplied by the Tar Products Corporation, Providence, R. I. Delivery of the treated lumber to the bridge was by motor truck.

The work of reconstruction was done by V. J. Grande, contractor, of Boston, under the supervision of the Parks Division of the Metropolitan District Commission. A detailed description of the work will appear in an early issue of *Engineering News-Record*.

Stairway Built at Same Time as Concrete Floors

A steel frame and concrete stairway for concrete buildings, designed for erection simultaneously with the floor forms so as to provide immediate



access between floors of a building under construction without resort to ladders or special service stairways frequently specified, has been introduced by the Deslauriers Column Mold Co., New York, from designs developed by J. R. O'Donnell and Herman Feldblet. The main feature of the new method of construction, called the Econo-Stair, is a frame of 8-in. channel stringers framing into 8-in. channel headers at floor and intermediate platform levels; the opposite ends of platforms are framed and carried by 4- or 5-in. channels. Intermediate platforms are supported on angle struts and all stringers and platform channels are connected with tie rods. Steps are of reinforced concrete formed with metal risers and metal soffit forms.

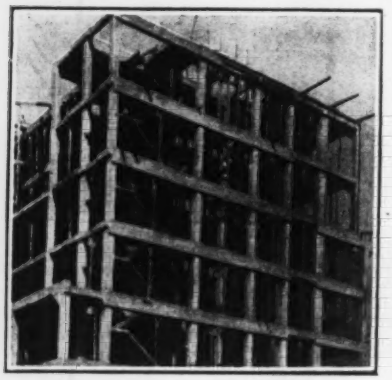
The following are the successive steps in the process of building the stairway: On the floor to be concreted the beam forms at the sides of the stair well are notched to receive an 8-in. channel floor header and provide a 4-in. bearing at each end. Then the intermediate platform header is erected with its supporting angle struts.

After clamps to support the riser and the soffit forms are set-screwed to the 8-in. channel stringers the latter are placed and to them are attached by means of hanger bolts telescopic metal soffit panels. The next step is the placing of the metal risers which are fastened to clamps by means of wrought iron pins. Prior to concreting a ⅜-in. reinforcing rod is placed in each step of the stairway and is tied to three ⅜-in. distributing rods. After 12 hr. of setting for the concrete the riser forms are stripped. The soffit forms are stripped in 24 hr., the steel channel stringers being left in place as part of the finished stairway.

On the average width of stair—3 ft. 8 in.—a pair of 8-in. channel stringers

will carry all spans of stairs from 3 to 14 risers. The construction is particularly suitable, also, for carrying a partition on the stair stringer. When the stair is used in a steel frame building it may be included in the skeleton frame design, thus including the material in the main steel contract instead of as a separate item.

This type of stair, its designers claim, weighs 60 lb. per square foot less than the ordinary type of concrete stair, or a reduction of about 2



tons per floor on the beam framing around the stair wells. Due to the use of steel riser and soffit forms, the stair is said to develop an excellent finish, requiring very little mason work. One of the main advantages advanced for this form of construction is that the monolithic pouring of stair and floor simultaneously eliminates a second pouring of the stairway and makes unnecessary the use of ladders to reach upper floor levels, thus reducing accidents to workmen. The stairway is adapted not only to the factory type of building, but also to higher types of structure such as hospitals, school houses and various types of commercial buildings. The chief advantages claimed for the type of stairway described are flexibility in design and construction, superior finish, speed of erection, and elimination of job accidents due to open stair wells and ladders.

The accompanying illustrations show the use of the stairway in the Houbigant Building, New York, for which Lockwood Greene & Co. were engineers and architects, and the Hegeman-Harris Co., Inc., contractor. The initial use of this stairway was made by the Barney-Ahlers Construction Corp. on one of its concrete building contracts.

Publications from the Construction Industry

Arc Welding and Cutting—GENERAL ELECTRIC Co., Schenectady, N. Y., has issued a cloth-bound 127-p. Manual for arc welding, with description of principles, operation, equipment and methods; there is also outlined a course of training for operators. Examples of welding include structural steel framing and roof trusses, lattice girders, tanks, pipe lines, hydraulic turbines and steel framing for reinforced-concrete.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Spring Holds No Promise of Lower Building Cost

No Abrupt Rise Expected—Materials Plentiful—Production Active—Bidding Close Among Builders

That construction cost will be slightly higher this spring than last, is the opinion of two out of three builders interviewed by *Engineering News-Record*. While they admit that labor is at present easier to get and without bonuses, a tightening up of the situation is anticipated in April and May of this year.

There are two points on which those who have carefully investigated the situation agree, they are: (1) that labor, particularly in the skilled trades, is more efficient than formerly; and (2) that if there is to be any drop in the cost of spring construction, to the owner, it will not be due to cheaper materials or labor but to competition among builders sufficiently keen to produce close bidding.

Since materials manufacturers and dealers and the skilled building trades hold out no promises of recessions from present schedules, the only thing that could cause lower cost of spring construction would be a drop in the volume of projected work.

NO SLACKENING OF PROJECTED WORK

A steady gain in the number of jobs out for bids, as published in *Engineering News-Record* since Feb. 1, would indicate no slackening in the volume of spring construction and consequently no decrease in cost.

At the materials producing centers, the present high production schedules indicate confidence in the spring market and at the same time allay all fears of materials shortages.

Steel demand is particularly heavy; unfilled orders are as numerous as in August, 1923, at which time structurals were selling at $2.50 per 100 lb., Pittsburgh mill. The price now ranges from $2 on heavy tonnages to $2.20 per 100 lb. for smaller lots, at mill. Any increase in demand will simply bring the price nearer to the $2.50 level. The one element interfering with this trend is the present tendency to purchase for replenishment of stocks. For the greater part of the past two years, buying has been for immediate needs only.

Cement demand is slower than a year ago. Maintenance of heavy production schedules and tremendous reserve mill stocks indicate no lack of confidence in the spring building demand.

The aggregates will closely follow steel and cement as to trend of prices, output and demand.

Brick is plentiful. This is in contrast with the scarcity complained of during the past three years. The slowing down in imports is due to the fact that the market is full. Strike movements on the part of ornamental iron workers, derrickmen and riggers in New York, in sympathy with structural iron workers, has contributed more to the piling up of brick reserves than actual loss of interest in construction. Heavy production schedules prevailing in this industry also reveal confidence in the spring building movement.

The trend in other clay products and also in lime is similar to that of brick.

Pine lumber demand is increasing daily. The situation in the fir lumber producing regions of the Northwest is quite the opposite. Mills, there, are shutting down to five-day week schedules in order to bring production nearer to the actual volume of demand. Lumber production, generally, is heavier than a year ago and that is another instance of confidence, on the part of manufacturers, in the spring demand.

The majority of buyers believe that such materials as non-ferrous metals (copper principally) and linseed oil, will go higher in the near future. Paint materials, other than linseed oil, and glass as well as other building materials are not expected to advance much above present levels.

Of twenty-one cities reporting regularly to *Engineering News-Record*, only six reveal any scarcity of mechanics or unsettled wage disputes. In Denver there are not quite enough bricklayers, although other crafts are plentiful. Kansas City lathers and hoisting engineers demand increases of 25c. per hr. over the present rate of $1.25 for the former and $1.12½ per hr. for the latter. The New York labor situation is disturbed by strikes among wire lathers' foremen; iron workers (structural and ornamental), derrickmen and riggers. The action of the ornamental iron workers, derrickmen and riggers lacks stamina and does not now threaten to cause much of a disturbance in spring building, owing to the fact that it was originally intended as an aid to the fast-warning strike movement of the structural iron workers, which began nearly a year ago. Cleveland plasterers and lathers demand $1.75 per hr. and a 40-hr. week; painters demand $1.50 per hr. and a five-day week. Both would then be slightly above the present scale. Pittsburgh iron workers and hod carriers demand advances of 25c. per hr., bringing the former to $1.50 and the latter to $1.25 per hr. Common laborers demand a rise of 30c. per hr., bringing their wage rate to $1 per hr. The Chicago situation has cleared up considerably, since the signing of an agreement between the Iron League of Chicago and the Structural Iron Workers Union. By the terms of the agreement the iron erectors will receive an advance of 12½c. per hr., making their rate $1.37½ per hr., effective June 1, 1925. It is reported that marble workers received a similar advance.

Call money quoted at 30 per cent, Feb. 21.

Time loans; short terms, 3½@3¾ per cent.

Commercial paper, best names, 3¾ per cent.

Use of Average Bids in Handling Minor Items on Estimates

With the idea of eliminating, or at least guiding, the guesswork usually involved in minor items on estimate sheets, the following tabulation of average bid prices is submitted by Alexander Lyle, Assoc. Mem. Am. Soc. C. E.

According to Mr. Lyle, contractors usually devote considerable care to the preparation of estimates on the major factors of a bid, at the same time giving little more than a guess at the minor items.

Generally, he claims, the major items are those most readily affected by local conditions. These are usually worked out in detail on the estimate sheets. In his opinion, the minor or less important items, affected very little by local conditions and outnumbering the major items warrant very little consideration in the preparation of an estimate and should vary little from a standard price.

This tabulation was accordingly compiled from unit bids on several sections of subway and tunnel construction in New York City.

The three lowest bids on each section have been averaged as shown in the table. In no case does the third bid exceed the lowest by over 50 per cent. The number of sections in which an item occurs is given in order to indicate the range covered.

Present Construction Trend Like That of 1923

Differs From Last Year In That West Is Gaining While New England Shows Slight Decline

The shift in leadership, so far as 1924 construction activities were concerned, from the Western states to the Northeastern section of the United States, is shown in the accompanying illustrations.

Fig. 1, depicting 1923 construction compared with the preceding year, shows especially favorable conditions to have existed in the Western states at that time, with the South and Middle

FIG. 1—VALUE OF 1923 CONTRACTS AS COMPARED WITH PRECEDING YEAR

FIG. 2—VALUE OF 1924 CONTRACTS AS COMPARED WITH PRECEDING YEAR

West not far behind. In the Middle Atlantic states construction was slightly under that of 1922, with New England considerably below the year just mentioned.

(*Continued on page 378*)

UNIT BID PRICES ON SUBWAY AND TUNNEL WORK

Classification	Unit	No. of Sects.	Bid Price Maximum	Bid Price Minimum	Bid Price Average	Per Cent Ratio of Max. to Min
Excavation—earth—above M.H.W.	Cu.yd.	6	$22.60	$3.60	$9.75	630
Excavation—earth—below M.H.W.	Cu.yd.	3	22.60	7.00	14.72	323
Excavation—earth—for sewers	Cu.yd.	8	22.60	3.50	9.65	645
Excavation—shaft—earth above M.H.W.	Cu.yd.	2	40.00	7.00	22.76	571
Excavation—shaft—earth below M.H.W. comp. air.	Cu.yd.	3	40.00	14.00	27.51	286
Excavation—rock	Cu.yd.	1	22.00	15.10	18.40	146
Excavation—shaft—rock in comp. air	Cu.yd.	3	51.50	10.00	38.91	515
Excavation—dredging	Cu.yd.	1	1.50	.60	1.05	250
Underpinning—bldgs. under 7 stories	F.ft.	1	50.00	42.00	46.67	119
Maint. protect. and securing buildings	F.ft.	1	38.00	1.00	18.00	3,800
Maintaining 66-in. aqueduct	Lin.ft.	1	60.00	10.00	40.00	600
Maintaining Canal St. sewer, 6x16 ft.	Lin.ft.	1	155.00	1.00	67.00	15,500
Excavation—tunnel—earth above M.H.W.	Cu.yd.	1	25.00	20.80	23.27	120
Excavation—tunnel—earth below M.H.W.	Cu.yd.	2	30.00	13.00	19.67	231
Excavation—tunnel—earth and rock	Cu.yd.	2	70.00	34.20	46.57	204
Excavation—tunnel—rock	Cu.yd.	2	80.00	32.00	52.57	250
Concrete masonry	Cu.yd.	8	35.00	10.00	18.23	350
Concrete masonry for shafts	Cu.yd.	3	40.00	12.00	23.51	333
Concrete masonry for tunnel	Cu.yd.	2	21.00	14.50	18.17	145
Concrete masonry—shaft in comp. air	Cu.yd.	3	40.00	18.50	28.75	216
Concrete masonry—tunnel in comp. air	Cu.yd.	2	36.25	25.00	30.42	145
Concrete—rubbing surface	Sq.ft.	5	.17	.03	.09	567
Concrete—resurfacing	Sq.yd.	1	5.00	1.50	3.00	333
Precast concrete forms	Sq.ft.	1	.60	.30	.47	200
Mortar batches in placing concrete	Bbl.	4	8.00	3.40	5.40	235
Concrete—protective	Cu.yd.	7	35.00	13.00	20.56	269
Rubble stone masonry	Cu.yd.	3	24.00	8.00	12.33	300
Rubble stone masonry—dry	Cu.yd.	2	12.00	6.00	9.17	200
Stone packing—dry	Cu.yd.	1	5.00	2.00	3.33	250
Brick masonry	Cu.yd.	7	65.00	25.00	39.81	260
Removal and disposal of old masonry	Cu.yd.	2	100.00	22.00	49.50	455
Disposal of ashes	Cu.yd.	1	.60	.35	.48	171
Granite masonry—shaft facing	Cu.yd.	2	150.00	90.00	116.67	167
Hollow T.C. brick or tile masonry	Cu.yd.	5	50.00	18.00	32.23	278
Hollow T.C. tile masonry, 2 in.	Cu.yd.	1	65.00	37.00	49.00	176
Hollow T. C. tile masonry, 3 in.	Cu.yd.	1	65.00	36.00	48.67	180
Hollow T. C. tile masonry, 4 in.	Cu.yd.	1	65.00	32.00	47.33	203
4½x13-in. T. C. flue lining	Lin.ft.	4	2.00	1.00	1.40	200
Grout of Portland cement 1:1	Bbl.	8	8.00	4.10	6.16	195
Grout of Portland cement 1:0	Bbl.	3	7.50	3.55	5.39	211
Grout of Portland cement 1:1 comp. air	Bbl.	3	9.50	5.75	7.41	165
Grout of Portland cement 1:0 comp. air	Bbl.	3	9.50	4.00	6.66	237
Mixed grout 1:1 in comp. air—Portland	Bbl.	2	6.55	3.50	5.35	187
Mixed grout 1:1 in comp. air—Natural	Bbl.	2	6.00	2.20	4.52	272
Mixed grout 1:0 in comp. air—Portland	Bbl.	2	5.50	4.00	4.50	137
Mixed grout 1:0 in comp. air—Natural	Bbl.	2	4.30	2.20	3.42	195
Reinforced concrete piles—20 in.	Lin.ft.	1	16.00	9.30	12.43	172
Reinforced concrete piles—24 in.	Lin.ft.	1	18.00	12.00	15.00	150
Timber piles	Lin.ft.	3	3.00	.70	1.41	429
Timber foundations	M.b.m.	1	100.00	90.00	96.67	111
Timber wharf (exc. piles)	M.b.m.	1	175.00	135.00	155.00	130
Timber wharf (inc. piles)	Sq.ft.	2	1.20	.10	.77	1,200
Tunnel timbering	M.b.m.	1	300.00	125.00	216.67	240
Timber temporary ramp	M.b.m.	1	100.00	95.00	98.33	105
Timber temporary bulkheads	M.b.m.	1	175.00	111.50	145.50	157
Fence—tight board	Lin.ft.	3	3.00	1.50	2.29	200
Broken stone or gravel	Cu.yd.	4	6.00	3.50	4.42	172
Waterproofing—1 ply	Sq.yd.	7	2.00	.50	.97	400
Waterproofing—2 ply	Sq.yd.	4	2.00	1.00	1.58	200
Waterproofing—3 ply	Sq.yd.	8	3.10	1.45	2.17	214
Waterproofing—4 ply	Sq.yd.	6	7.35	2.00	3.36	368
Waterproofing—5 ply	Sq.yd.	2	4.00	2.50	3.28	160
Waterproofing—6 ply	Sq.yd.	8	6.90	2.50	3.86	276
Waterproofing—dry ply	Sq.yd.	5	1.25	.25	.67	500
Waterproofing—4 ply in comp. air	Sq.yd.	1	12.00	4.40	7.80	273
Waterproofing—6 ply in comp. air	Sq.yd.	1	15.00	6.30	10.77	238
Waterproof—4 ply with brick—comp. air	Sq.yd.	3	20.00	6.20	13.37	322
Waterproof—6 ply with brick—comp. air	Sq.yd.	3	25.00	8.00	16.65	312
Waterproofing—brick in mastic	Cu.yd.	6	85.00	40.00	45.26	212
C. I. pipe and fittings—3 in.—ex. hy.—drains	Lin. ft.	5	3.25	.90	1.38	362
C. I. pipe and fittings—4 in.—ex. hy.—drains	Lin.ft.	1	2.00	1.00	1.45	200
C. I. pipe and fittings—6 in.—ex. hy.—drains	Lin.ft.	5	4.25	1.25	2.08	340
C. I. pipe and fittings—8 in.—ex. hy.—drains	Lin.ft.	5	8.00	1.50	3.08	533
C. I. pipe and fittings—10 in.—ex. hy.—drains	Lin.ft.	2	8.00	3.00	4.44	267
Galv. wt. st. pipe and fittings—1 in.	Lin.ft.	2	40	12	27	333
Galv. wt. st. pipe and fittings—1¼ in.	Lin.ft.	2	60	18	39	333
Galv. wt. st. pipe and fittings—2 in.	Lin.ft.	3	1.50	25	69	600
Galv. wt. st. pipe and fittings—2½ in.	Lin.ft.	2	1.10	36	72	306
Galv. wt. st. pipe and fittings—3 in.	Lin.ft.	5	7.00	50	1.63	1,400
Galv. wt. st. pipe and fittings—4 in.	Lin.ft.	4	13.00	75	2.49	1,735
Galv. wt. st. pipe and fittings—6 in.	Lin.ft.	2	17.00	2.00	4.93	850
Tunnel ducts—single way	D.ft.	8	40	16	25	250
Tunnel ducts—two way	D.ft.	2	20	18	19	111
Tunnel ducts—three way	D.ft.	2	20	18	19	111
Tunnel ducts—four way	D.ft.	2	20	17	18	118
Tunnel ducts—six way	D.ft.	2	20	16	18	125
Railroad ducts	D.ft.	1	40	20	30	200
Fibre conduit—3 in.	D.ft.	3	3.00	.25	.78	1,200
Architectural steel and iron	Ton	5	600.00	186.00	286.67	322
Riveted steel	Ton	8	250.00	90.00	134.06	278
Riveted steel for caissons	Ton	3	250.00	145.00	191.22	172
Removing and resetting columns	Each	1	100.00	50.00	83.33	200
Steel sliding doors—complete	Sq.ft.	2	12.00	2.00	6.67	600
Emergency exit covers	Each	2	1,000.00	240.00	456.67	417
Steel beams and shapes	Ton	8	195.00	81.00	116.41	241
Steel connecting rings in shaft	Ton	2	225.00	175.00	200.00	129
Steel rods and bars	Ton	9	120.00	65.00	98.67	185
C. I. tunnel lining	Ton	2	64.00	47.50	58.20	135
C. S. tunnel lining	Ton	2	90.00	70.00	81.84	128
C. S. tunnel lining pile segments	Ton	2	100.00	85.00	94.25	118
Tunnel bolts (high tens. steel)	Ton	2	200.00	150.00	171.67	133
Sheet steel piling	Sq.ft.	1	2.10	1.50	1.77	140
Miscellaneous iron castings	Ton	6	400.00	120.00	210.72	333
Miscellaneous C.I. sewer furnishings	Ton	8	350.00	100.00	168.46	350

Weekly Construction Market

THE cost of construction is now about 5 per cent below that of a year ago and has been receding gradually since the first of the current year, a characteristic directly in contrast with the trend of the corresponding period in 1924.

Judging from the value of building permits issued and steady gains in the number of jobs out for bids, March cost should be a trifle above the current level.

Current buying practice is tending largely toward purchasing for future delivery and also for replenishment of stocks. Contrasted with the recent hand-to-mouth methods, the buying for replenishment would indicate the absence of acute demand and would also serve to act as a brake on excessive costs.

The actual volume of current business is reflected in the unseasonably heavy freight movements throughout the country.

During the week of Feb. 7, railroads moved 298,244 cars of revenue freight, all classes, according to the American Railway Association. This is compared with 906,017 cars for the corresponding week last year and 849,352 cars during the same week in 1923. In fact, since Jan. 10, 1925, loadings have been well above the 900,000 cars-per-week mark.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.15	$3.35	$4.25
Structural rivets, 100 lb	4.25	4.45	4.75	3.50	3.75	4.65	5.00	3.80	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	3.00	3.25	3.87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	54.2%	43%	56½%	54.25%	36%	44.7@55.5%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	54.60@55.60	58.00	56.00	49.20@50.20	55.50	62.00	53.00	65.00	60.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.25	1.40	2.00	3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.00	2.83	3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	60.00	34.00	56.00	55.00	39.75	39.75	29.00	23.50	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.50@2.75	1.45	1.85	1.26	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	12.10	12.00	13.50	12.00	15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal	1.24	—1.23	1.30	1.25	1.23	1.42	—1.27	1.12	1.11
Common Labor									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50	.20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 5, the next on March 5.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.90). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Present Construction Trend

(*Continued from page 377*)

In 1924 the situation was quite the reverse, as shown by Fig. 2. During the year just closed, construction slumped to a slight degree in the Western states and dropped considerably in the Great Lakes region, compared with 1923. The eleven northeastern states were well above the preceding year in money value of contracts let.

The gain in the South has been steady, each year showing a heavier total than the one before it.

One explanation of this change in the local trend of construction activity is that the depressed conditions of the agricultural industry influenced the situation in the Western states during the early part of 1924, while resumption of production in the textile industry late in the year, served to stimulate building in the Northeastern section.

The 1924 trend is still being followed in the Middle Atlantic states and the Far West. New England threatens to slump back into the building conditions prevailing there in 1923, while the states west of the Mississippi are all showing substantial gains in contract letting.